Charles University in Prague

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MASTER THESIS

Inflation Targeting Performance in Emerging Economies and Some Lessons for Moldova

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Declaration of Authorship

The author hereby declares that he compiled this thesis independently, using only the listed resources and literature.

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Prague, July 29, 2013

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Signature

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Abstract

The present paper has attempted to provide an empirically argumented basis on the existing conflict about effectiveness of IT regime on lowering inflation and inflation volatility. In the first part we perform panel analysis on a group of 43 emerging and developing economies for a more recent period ranging from 1997 to 2011, distinguishing between normal and crisis times as well as between geographical regions. Differently from common studies we applied dynamic panel model specification that controls for reverse causality of regime adoption. Despite broad arguments addresing IT ineffectiveness, our results support the regime and imply that shifting to IT will lower both inflation and inflation volatility in normal times. Model specification during the external shocks was inconclusive on the selected sample with relatively recent IT history. Regarding the geographical IT performance, we outlined that regime effectiveness was uniform along analyzed regions. In the second part we perform a preliminary analysis of a developing economy IT experience and conclude that, even though there are some problems of technical nature and main policy rate is still a weak instrument of transmission channel, the Republic of Moldova chose right time for regime adoption and has made considerable progress towards the successful framework implementation.

JEL Classification: E31, E42, E52, E58.
Keywords: Inflation targeting, dynamic panel, monetary transmission, VAR.

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Acronyms

AR	Autoregression Model
CEE	Central and Eastern Europe
CIS	Commonwealth of Independent States
CPI	Consumer Price Index
GDP	Gross Domestic Product
IRF	Impulse Response Functions
IT	Inflation Targeting
MA	Moving Average
NBM	National Bank of Moldova
NIT	Non Inflation Targeting
OECD	Organization for Economic Cooperation and Development
OLS	Ordinary Least Squares
PLT	Price Level Targeting
SVAR	Structural Vector Autoregression Model
UNECE	United Nations Commission for Europe
VAR	Vector Autoregression Model

Master Thesis Proposal

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Proposed Topic:

Inflation Targeting Performance in Emerging Economies and Some Lessons for Moldova.

Topic Characteristics:

Inflation Targeting (IT) is a relatively new monetary policy framework firstly adopted by New Zealand in 1989, which has nowadays a rising market share among other monetary policy regimes. It is mainly about setting monetary policy conditions such that inflation projections that follow from the last meet inflation target at an appropriate horizon.
Inflation Targeting efectiveness is nowadays viewed partly controversially. Some economists find no significant evidence of lowering inflation (Ball and Sheridan) while others state its significance on price stability, especially in emerging economies (Wu, Cabral). More recent stream of literature focused mainly on after-crisis period suggest that IT has helped to avoid deflationary pressure and to achieve faster recovery (Carvalho Filho). Furthermore there is evidence that IT influence on lowering inflation varies even within emerging countries (Baxa, Plasil, Vasicek).
Taking in cosideration the existing opinions about the IT, we would like to investigate the 15 year performance of this monetary policy regime in emerging and developing markets in order to come up with our own conclusions and explanations and compare the final results with the existing studies. One important point is that we will account for a vigorously discussed reverse causality of the regime adoption. In addition, the performance within the target group of IT countries will be examined depending on their geographical position. Moreover, we intend to investigate IT experience of the Republic of Moldova, a developing economy, which experiences the above mentioned regime from 2010. We plan to analyse its readiness for IT regime, i.e the matching of the neccesary preconditions and possible future developments as well as monetary policy transmission mechanism of the National Bank of Moldova. We think it will be useful to develop some policy recommendations in order to further succesfully implement and adapt the regime to country specific situation.
In my opinion the topic is relevant due to the fact that there is limited literature focusing on IT accomplishments before and after the recent crisis and the one that exists has ambiguous conclusions. In addition, the analysis of a developing country preconditions and initial performance can be useful for other economies in transition wishing to implement this monetary policy regime.

Hypotheses:

1. IT countries have experienced lower inflation and inflation volatility after adopting the new regime. Does this hold in both pre-crisis and crisis periods?
2. CEE countries have a better performance of IT. Does IT performance depend on geographical position of a country?
3. Suitability of the Republic of Moldova for framework implementation. Does RM choose the right time for IT adoption meeting all the necessary preconditions?

Methodology:

We intend to use dynamic panel estimation which will account for potential endogeneity of the regime adoption proposed by Brito and Bystedt (2008) controlling for regression in mean and high inflation. The model is applied on a panel data of emerging and developing economies consisting of both IT and NIT countries with country and time fixed effects with a dummy variable, indicating whether the country is currently an inflation targeter. The two-step system GMM estimator compares the average change in the inflation rate for the countries in the treatment group (the official adoption of the IT regime) relative to the average change in the inflation rate in the control group (other monetary policy regimes) over the same time.
The treatment effects of IT on inflation (*CPI*) is defined as the annual growth rate of *CPI*, and on inflation variability, defined as the standard deviation of a three-year moving average of detrended series of inflation.
Data will be taken from International Monetary Fund's World Economic Outlook Database.

Outline:

1. Introduction
2. Literature review
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4. Empirical estimation of IT performance in EME
5. Case study on Republic of Moldova IT fresh experience. Analysis of the preconditions
6. Policy recommendations
7. Discussion and conclusions
8. References

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Supervisor

Introduction

Being a relatively new monetary policy framework, firstly adopted by New Zealand in 1989, inflation targeting (IT hereafter) represented a completely novel look at monetary policy being mainly about setting monetary policy conditions such that inflation projections that follow from the last meet inflation target at an appropriate horizon. Basically, it is a forward looking regime which is based on targeting inflation expectations rather than inflation *per se*.

Its formal objective of price stability is achieved through a commitment to stick to a specific level of inflation stated publicly, implemented and maintained with the help of three pillars of a modern central bank: independence, transparency and accountability. In more detail, independence pillar has a role of preventing inflation surprises enforced by governments, accountability stands for preventing deflationary shocks by the central bank as well as for making up for the democratic deficit of an independent institution and transparency increases efficiency of transmission mechanism of monetary policy *via* managing expectations.

Starting from its apparition, IT effectiveness has always been seen controversially in the literature. Some economists find no robust evidence of lowering inflation while others state its significance on price stability, especially in emerging economies. In addition, the recent financial crisis has urged IT opponents by reconsidering the problem of financial stability and too narrow focus of the framework. Even so, regime proponents suggest that it can help to avoid deflationary pressure and to achieve faster recovery (Caralho Filho, 2011). Furthermore there is evidence that IT influence on lowering inflation varies even within emerging countries (Baxa, Plasil and Vasicek, 2012). For the reasons discussed above and because of a continuously growing number of emerging and developing economies, that have adopted the regime or aspire to do so in the near future, we decided to make our own analysis which will

account for potential weaknesses of the previous works. Furthermore, in the present paper we will try to find answers to the next questions:

1. EME inflation targeters have experienced lower inflation and inflation volatility after adopting the regime. Does this hold in both pre-crisis and crisis periods?
2. CEE countries have a better performance of IT. Does IT performance depend on geographical position of a country?
3. Suitability of the Republic of Moldova for framework implementation. Does RM choose the right time for IT adoption meeting all the necessary preconditions?

The present study will focus on emerging as well as developing low-income countries as it offers a greater heterogeneity and larger spectrum of analysis, although some references and analogies will be drawn from the advanced economies experience. To our best knowledge, a relatively limited literature is developed and focused on IT in low-income countries, which in addition analyzes the first realizations of the regime of a developing economy.

Our main goal is to fill the gap in the current debate on IT effectiveness focusing especially on developing economies and trying to assess if the recent crisis has induced any modifications. We also want to empirically document whether there is any difference in regime performance in several parts of the world, and if geographical position mattered for fulfilling the IT goal. Unlike all major papers we account for endogeneity of IT adoption discussed by Gertler (2005), Mishkin and Schmidt-Hebbel (2006) and others by applying the dynamic panel estimation proposed by Brito and Bystedt (2008) on our sample of 43 countries within a more recent time span, which excludes the early 90's period of hyperinflation that may bias the results in favour of the IT regime. The employed model relies on two-step system General Method of Moments that is developed to capture the main critique of reverse causality of the regime adoption and provides unbiased and more efficient parameter estimations.

Additionally we perform a preliminary analysis of a Republic of Moldova experience with the IT regime. Being a relatively new regime for the country

one might argue that it is premature to elaborate on its effectiveness on anchoring inflation expectations and lowering inflation. Nevertheless we believe it is useful to make an analysis of framework compatibility with stylized preconditions for IT adoption as well as to assess regime's first realizations and evaluate current state of functioning of monetary transmission mechanism, which besides the National Bank of Moldova itself may be useful for other countries with similar environment aiming towards the regime adoption and facing the same challenges.

The thesis is structured as follows. Part I discusses the IT regime in emerging and developing economies. In Chapter 1 we elaborate on the inflation targeting regime emergence and summarize the most relevant empirical literature focused on IT framework effectiveness delimiting between pre and post crisis view on the regime. We are also trying to assess whether the "state of the art" regime survived the recent economic turndown. Chapter 2 introduces the econometric model proposed by us for hypothesis testing and summarizes our main findings regarding IT impact on inflation and inflation volatility in both "normal" and crisis times. Additionally, we evaluate whether there are any regional differences in inflation targeting performance among different parts of the world. Chapter 3 outlines our main conclusions for the first part of the paper. Further, Part II is dedicated to a case study on the readiness of the Republic of Moldova for the regime. Chapter 4 concentrates on fulfilment by the National Bank of Moldova (NBM) of the necessary preconditions for IT adoption. Chapter 5 provides insights on the NBM monetary policy transmission mechanism analysis. Finally, Chapter 6 outlines our main findings and develops some policy recommendations.

PART I:

Inflation Targeting in Emerging and Developing Economies

CHAPTER 1

Inflation Targeting in Practice

1.1 Some Thoughts on Inflation Targeting Background

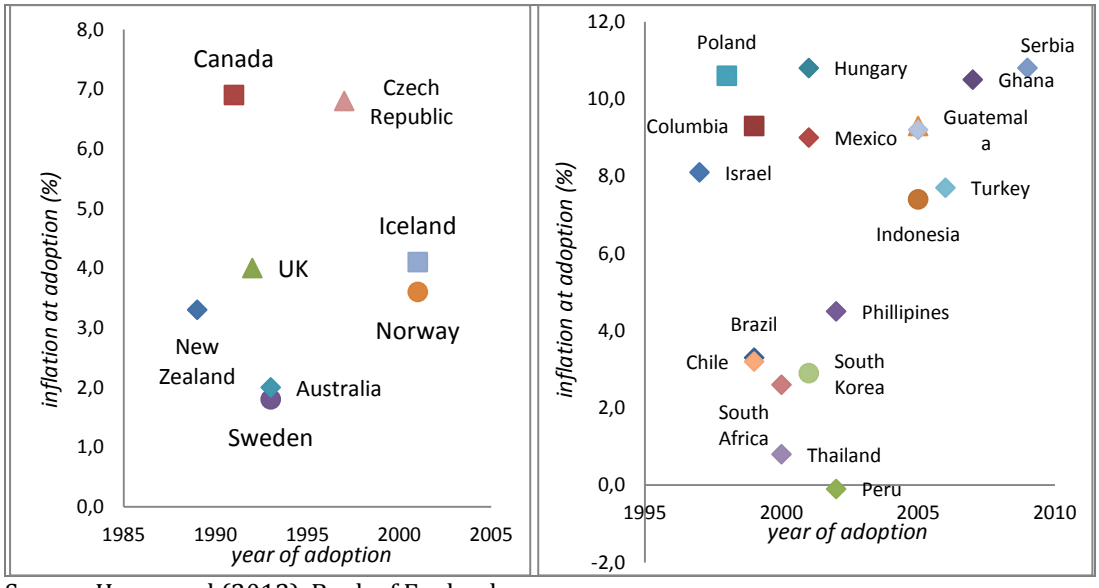
Emergence of the IT framework can be seen as a practical response to economic evolution in the 20th century. This evolution started in 1970 with collapse of the Breton Woods system. The forthcoming monetarism view elaborated by Milton Friedman prevailed in the economic theory in the 1980s but faced a lot of challenges in a number of countries due to unstable money demand. In addition, growing international capital mobility increased susceptibility to shocks under pegging exchange rate regime and low credibility of both monetary and fiscal policy together with high balance sheet exposure induced higher incidence of speculative attacks and currency crisis in the 90s (Masson et al., 1997). Ultimately, Hammond (2012) argues that IT with floating exchange rate emerged as a consensus framework vision consistent with realistic achievements expected from a monetary policy.

It is generally believed that monetary framework with well anchored inflation expectations is able to achieve good outcome in terms of the trade-off between price stability and real output variability. Theoretically, this idea was

incorporated in 90s into the New Keynesian Phillips Curve[1]. Furthermore, inflation targeting setting is considered the most appropriate candidate for the optimal policy as it accounts not only for past and present actions but also for forward commitments of monetary authorities. As argued by Svensson (1997), loss function of a central bank is positively dependent on deviations of actual inflation from the target, therefore optimal decision of a central bank is to anchor inflation expectations to the target. The author also distinguishes between strict and flexible IT regime. The latter one is practiced by central banks in reality, representing a more gradual approach of achieving the target in a medium-term taking into account the output variability and potential shocks. Ultimately it creates space for other policy goals like smoothing the output and therefore is less costly in terms of real economy. Furthermore, it can be inferred that IT is mainly about anchoring inflations expectations and building credibility rather than hitting a target.

IT has nowadays a rising share among other monetary policy regimes both in advanced and emerging economies.

Figure 1.1: Inflation targeting countries by year of adoption (advanced economies –left, emerging economies – right)



Source: Hammond (2012), Bank of England

[1] NKPC: $\pi_{t+1} = E\pi_{t+1} + \alpha y_t + \varepsilon_t$, and ($E\pi_{t+1} = \pi_{t)}$, where π_t- level of inflation in period t, $E\pi_t$- inflation expectations in period t, y_t- -output gap and ε_t are shocks

According to Bank of England estimations, at the beginning of 2012 there were 27 countries, which explicitly target inflation, among which 8 advanced and 19 emerging economies. The figure above represents advanced and emerging IT countries grouped by year of adoption and initial inflation at the time of targeting. It is worth mentioning that IT framework is extremely popular among emerging economies starting from the late 90s. It can be observed that the countries are very heterogeneous it terms of initial inflation by the year of adoption, some of them having double-digit initial inflation (Serbia, Hungary, Poland) contrasting with the others with already very low (South Africa, Thailand) or even negative inflation process (Peru), serving as evidence that some countries adopted the regime in order to escape from high inflation while others had a goal of anchoring inflation expectations at an already low level.

What about practical performance of inflation targeting countries, was it more successful than other monetary policy regimes so far?

When it comes to empirical performance of the framework, there is no consensus view on its effectiveness in achieving low inflation. The critics are mainly addressed from the analysis of its effectiveness in developed economies while emerging markets seemed to be more successful in terms of causal effect of the regime on price stability. Having this in mind we will further provide the survey of most relevant literature of IT realizations focusing on two periods, delimited by the recent economic turndown, trying to answer if there were any modifications or difficulties affecting the regime.

1.2 IT Experience Before the Crisis

A commonly used methodology to study the influence of monetary policy extended in a series of studies afterwards, is proposed by Ball and Sheridan (2003) and represents difference–in-difference setting. The main idea is to divide the analysed countries into treatment (IT) and control (non-IT) subsamples and regress change in inflation on the IT dummy variable. The authors applied it to a sample of 20 OECD countries and found that inflation targeting did not matter for disinflationary processes or for other economic

improvements in selected countries. The possible interpretation of their results may be selection bias, as ultimate lowering of inflation is a natural outcome if the initial pre-targeting performance of countries is bad (Mishkin, 2001). Additionally, Gertler (2005) questions the choice of Ball and Sheridan's control group that consisted mainly of countries with a monetary regime very close to inflation targeting.

Slightly different outcome of a similar model is generated for emerging economies, where a significant decrease in average inflation is registered (Cabral, 2006). These results are supplemented by Gonsalves and Salles (2006), who estimated reduction in inflation (ranging between 2-2,5%) and in output growth volatility (up to 1,5%), although no significant reduction in inflation variability was found. One may argue that difference-in-difference applied to cross-sections does not account for the fact of varying starting dates of the explicit targeting period. Gonsalves and Salles (2006) use different starting periods as robustness check for the results which gave the same outcome.

Among other regime optimists are Neumann and Von Hagen (2002) who conclude that inflation targeting mattered for achieving disinflation and lower volatility of policy rates and inflation in the short-run. Although the superiority of the framework over other monetary policy regimes was rejected, the authors claim that IT-ers are much more flexible in their responses to external shocks.

Another extension is Wu's (2004) analysis developed on a panel of 22 OECD industrial economies who is applying a multi-periods difference-in-difference to quaterly CPI inflation rate. His results gave a another space for interpretation of IT performance in advanced economies, particularly he finds that decrease of average inflation is not generated by mean reversion or increase in real interest rates (more aggressive monetary policy) but is rather caused by the effectiveness of IT framework.

The result that IT countries outperformed on average their peers is suggested by Batini et al. (2006), who make an analysis of the experience of emerging and developing countries with the regime. Their results also shed light on the increased flexibility of the framework as countries that have

decided to implement it were able to adapt it to different initial conditions and country specific developments.

Although inflation targeting in emerging economies is believed to have a substantial performance in terms of lowering inflation, concomitantly they face challenges in hitting the target due to imperfect macroeconomic environment with weak institutions and credibility (Fraga, Goldfajn, Minella, 2004). Hence, the latter highlight transparency and communication as playing the key role in the process of building credibility.

As it can be noticed there are different empirical outcomes on IT efficiency. Apart from the shortcoming of a biased sample that causes endogeneity in the treatment variable argued by Mishkin (2002) and Gertler (2005), there is an interesting finding suggested by Mishkin and Schmidt-Hebbel (2006) that IT performance results depend on the choice of control group. Thus the highest achievements in lowering inflation is obtained when comparing IT with their own pre-targeting levels in both industrial and emerging economies and there is no significant effect relative to a control group consisting of successful non-targeters. These results are intuitive hence the last already had low inflation. They also argue that once hitting the target and gaining credibility, IT contributed to decreasing inflation and output volatility, reduced their response to external shocks, improved monetary system efficiency and strengthened monetary policy independence.

A different methodology of cross-sections analysis in assessing IT performance is proposed by Lin and Ye (2008). Using propensity score matching models they concluded that IT mattered only for emerging markets in achieving disinflation and lower inflation volatility recalling that developing economies relative to advanced had bigger room for gaining credibility.

Further we discovered evidence that IT influence on disinflation process varies within countries. A study of Baxa, Platil and Vasicek (2012) focusing on evolution of inflation dynamics in CEE countries (Czech Republic, Poland and Hungary) reveals an interesting perspective of IT framework in emerging economies. With the help of New Keynesian Phillips Curve and Bayesian

techniques they stress that the nature of inflation process differs significantly among selected countries. Though altogether they have a dominant forward-looking component of inflation, Czech Republic is the leader when it comes to almost disappearing inflation persistence and low variance of inflation shocks. Ultimately it can be inferred that the country has most credible monetary policy regime with well-anchored inflation expectations.

Gertler (2005) critics that commonly used difference-in-difference approach lacks empirical consistency being affected by identification problems and specification biases that after being controlled for also generate irrelevant results for inflation targeting regime performance. The author argues that decision to adopt the above mentioned regime is subject to reverse causality. On the one hand usually high inflation induces countries to target inflation; on the other hand the regime adoption stimulates disinflation process. This endogeneity makes him questioning the applicability and reliability of difference-in-difference methodology for the research.

The above discussed problem was accounted by Bryto and Bystedt (2008) who also consider that targeting decision is not random and depends on some country characteristics taken at different times. The authors develop a dynamic panel framework that considers possible endogeneity of IT adoption and country and time specific characteristics that may bias OLS estimates. Therefore, the authors apply 2 step system Generalized Method of Moments (GMM hereafter) estimator on unbalanced panel of 46 emerging economies and found evidence of IT helping to reduce inflation levels by having an adverse impact on output growth; however the effectiveness of the regime on lowering inflation is sensitive to modifications in the control group.

A similar econometric framework (two-step system GMM) performed on a sample of low income countries generated optimistic results. Gemayel et al. (2011) obtained significant negative coefficient of IT dummy on inflation, inflation volatility and output growth volatility. A difference between the last 2 authors concerns inflation-output growth trade-off, Gemayel and others findings suggesting no adverse impact on output growth.

1.3 Tackling the Crisis

The recent financial crisis from the late 2007 was accompanied by sharp and persisitent decline in aggregate demand. The latter created downward pressure on prices and inflation, inducing monetary authorities to cut interest rates to zero lower bound and to use unconventional monetary policy tools. This situation has reassessed the role of financial stability within monetary policy considerations and has brought back the debate of too narrow focus of inflation targeting and questioning of its functionality.

A relatively limited literature is focused on inflation targeting regime performance in times of economic shocks. One of the first authors who questioned regime effectiveness in critical times were Mishkin and Schmidt-Hebbel (2007), who by using panel VAR impulse response functions, established that a treatment group of IT countries have a smaller inflation response to an oil price shock after 1997. Even so, this fair sensibility is observed mostly in emerging economies with already stationary target that managed to gain credibility and anchor inflation expectations.

Neumann and von Hagen (2001) also compare inflation and interest rates response elasticities of the targeting and non-targeting countries during oil crises. Applying difference-in difference methodology they found that changes in both analyzed variables were smaller for the treatment group of inflation targeting countries, even though not statistically credible in case of inflation.

One of the harshest critics to inflation targeting framework that appeared during the crisis was done by Stiglitz (2008) who declared that „Today, inflation targeting is being put to the test –and it will almost certainly fail". From the very beginning the economist propagated the idea of uselessness of the regime in developing economies due to their sensitivity to external conditions like oil and food prices, which augmented by financial slowdown conditions, will worsen even more their development prospective.

A potential response to Stiglitz' critique was generated by I. De Carvalho Filho (2011). Using panel approach with country and time fixed effects the

author suggests that IT has helped to avoid deflationary pressure and to achieve faster recovery in terms of higher post-crisis GDP-growth, lower unemployment and smaller output loss and mentions that IT performance is being driven probably by different determinants in pre and post crisis periods. Particularly, in the early phases of the crisis strict monetary policy framework together with a flexible exchange rate regime served as shock absorber, reducing debt booms and demand for foreign assets. Furthermore, in the after-phase IT countries with well-anchored inflation expectations „can pursue more aggressive monetary easing" as they have an advantage in the direction of preventing liquidity trap and zero lower bound on interest rates at the time of deflationary shocks. The effectiveness of these findings is stronger for emerging economies.

Among other IT optimists can be numbered Fouejieu (2012), who affirms that increase in policy rates and inflation volatility during the crisis was less pronounced for targeting countries relative to non-targeters. The author also mentions several factors while answering the question of why IT countries are expected to do better during the recent crisis. Among them can be cited established credibility, firm control of inflation, better fiscal management, smaller volatility of exchange rates and higher international reserves accumulation. The latter argument is very important especially for emerging economies since it guarantees less costly access to funding in international markets as they do not have a global lender of last resort (Calvo, 2010).

A different perspective of inflation targeting policy setting is brought by Benecka et al. (2012), who elaborate on central bank's ability to maintain price stability in relation to its financial exposure. This fact is being extremely important especially after the recent crisis. Employing a panel approach and extending the framework proposed by Kluh and Stella (2008), the authors got the results, which confirm the influence predominantly of IT and other variables such as level of economic development, capital account openness and fixed exchange rate regime on achieving lower inflation rather than of selected measures of financial strength, which have no significant explanatory power on inflation.

As mentioned earlier the recent financial crisis has resulted in reaching of zero lower bound by some central banks and forcing them to use unconventional monetary policy instruments. Consequently, it has led to a reassessment of the possibility of price level targeting (PLT) to be an alternative to inflation targeting framework when overcoming the deflationary pressure. Similar to IT, PLT establishes a nominal anchor (price index) as a main tool of monetary policy conduit. In contrast to IT, almost forward looking regime, PLT also takes into consideration past developments of the index. To put it simply, if in previous period price level increased by some level from a theoretical base, next year it will have to decrease back to the targeted path.

Both Svensson (1996), Clarida et al. (1999) argue that PLT improves long-run trade-off between inflation and output variability. In addition Svensson(1996) shows that in countries with high output persistence PLT can be seen as more efficient framework. These conclusions are however sensitive to assumptions (Bohm, 2012), and in the short run, PLT causes the opposite effect on volatility of output and inflation. In addition existing models are too simple to capture the complexity of the framework and lack of practical experience induce doubts in the effectiveness of the regime.

Interestingly, Cecchetti and Kim (2005) mention the hybrid targeting which combines both price level and inflation targeting framework because of dual persistence of backward and forward looking individuals in the economy. However, the complexity of the resulting regime is expected to be too high and multiple objectives will significantly complicate the communication process and adjustment of expectations of the agents.

Despite the fact that theoretically PLT looks effective in reducing uncertainty about future prices in the long run, there are serious doubts to consider it as an alternative to IT framework. First, even in long horizon the costs of stabilisation remain high (Gerberding, 2010). Second, existing models do not capture all the complexities of the real economy. Third, practical experience is too distant and vague to make any valuable assumptions. Finally, despite its increased trasparency, PLT framework complicates communication

process of modern central bank and affects agents‘ ability to form inflation expectations thus generating time-inconsistency problem.

As we can observe numerous aspects of IT are discussed in the literature and ambiguous conclusions can be drawn. First of all it is associated with no significant effect in improving macroeconomic conditions in advanced economies. IT effectiveness on lowering and stabilizing inflation and real economy is rather believed in EME, although they face numerous challenges in implementing the regime, like the lack of credibility and transparency and very frequent target missing. At the same time in order to anchor inflation expectations and establish good reputation, these countries also have more space for improvement. The recent global economic and financial slowdown did not significantly reverse these findings. Nevertheless, a general inference which can be drawn is that IT setting has a “non-negative” performance (Walsh, 2009). It did not worsen economic conditions of countries that operate with it as monetary framework even after the crisis, hence no country has left IT regime so far, except Slovak Republic, Spain and Finland, which abandoned it due to entering the euro area. Roger and Stone (2005) assign this resilience of the inflation targeting to “the flexibility of the framework, high standards of transparency and accountability and lack of realistic alternatives”.

CHAPTER 2

The Analytical Framework

This chapter highlights empirical framework applied for testing inflation targeting regime effectiveness. Hence, it covers the procedure of sample selection, description of the econometric set-up and empirical results obtained in the proposed specification.

2.1 Sample Selection and Preliminary Data Analysis

The aim of this paper is to analyze the effectiveness of a monetary policy regime particularly focusing on emerging and developing economies unlike all major studies oriented towards advanced and emerging markets. Inflation behavior is examines based on percentage change in annual CPI ranging from 1997 to 2011 (15 years) selected from International Monetary Fund World Economic Outlook database (IMF WEO).

Since in one of our hypothesis we want to analyze the IT policy impact on different territories, we chose all countries from different regions where IT regime is adopted. We employ a size cut off of 10 billion USD dollars in 2004 nominal GDP (median year from our sample) to improve comparability among countries. Additionally we restrict our sample to countries with available data for the variable of interest (which excludes Lithuania and Bosnia and Herzegovina) and to countries that adopted IT prior to 2009 (which excludes Serbia), so that we have at least 3 years of reaction to the policy. For Bulgaria one observation (1997Y) was dropped due to extremely high CPI rate above 1000 percent thus unbalancing our sample panel.

Ultimately we ended up with 43 emerging and developing economies out of which 15 are inflation targeters (Brazil, Chile, Colombia, Ghana, Hungary, Poland, Romania, Indonesia, Peru, Philippines, Turkey, South Africa, Thailand,

Guatemala, Mexico) and 28 have other monetary policy regimes. As a robustness check, a group of CIS countries which match the previously mentioned criteria is added to the control group. The first country from our treatment group to adopt inflation targeting regime is Poland (1998) and the last one is Ghana (2007). Initial panel analysis, time series plot and descriptive statistics of the data and are presented in table A.1, table A.2, figure A.1, Appendix A.

The figure below is a graphical representation of table A.3, Appendix A. It represents average inflation for the selected sample.

Figure 2.1: Average inflation for the selected sample

Source: Author's calculations based on data selected from IMF WEO.

In case of inflation targeting countries it also includes average inflation prior and after regime adoption. Almost all countries from our treatment group have lower average inflation after the regime adoption; the only exception is Brazil, but it may be caused by low number of observations for NIT-ing period as country adopted the framework in 1999, while our sample starts in 1997. In general terms, on the overall sample, the inflation targeters have on average 7 percentage lower inflation than the control group of countries with other monetary policy regimes.When speaking about the volatility of inflation, it also

has had almost 23 percentage points higher value for non-targeters than for our treatment group (figure A.2, appendix A).

2.2 Model Specification

Apart from endogeneity of regime adoption mentioned by Gertler(2005) and Mishkin and Schmidt-Hebbel (2002, 2007), establishing inflation targeting regime may be very often related to country's individual characteristics and time trends (Brito, Bystedt, 2008) which cannot be captured by cross-section difference-in-difference analysis. Therefore we will employ techniques of dynamic panel data with country and time fixed effects measuring change caused by IT adoption on inflation (inflation variability) for a treatment group over a specific period relative to control group for the same period accounting for potential reverse causality and omitted variable bias.

The framework is similar to Bryto and Bystedt (2008) paper discussed earlier, applied on a different sample of emerging and developing economies. Consequently, we develop a more recent framework analysis on a time span dating from 1997 up to 2011. Further, inflation is summed over 3 year periods', thus maintaining the long memory of the series, giving time for a slow reaction and at the same time keeping the number of instruments low, which is necessary condition for GMM estimation[2]. Finally, we employ a similar transformation of inflation: $y_{i,t} = 100 * \ln(1 + CPI_{i,t} / 100)$ due to low number of countries in a sample and substantial skeweness detected in the data (table A.2, appendix A), which may affect the inference. As proposed by the authors we introduce a threshold dummy to control for high inflation as it can bias the results in favor of IT. Thus it takes value of one in case CPI is higher than 50 percent. Finally, the lagged dependent variable is included in the model to account for potential reversion to mean.

The measure of inflation volatility is obtained using 3 years standard deviation of detrended inflation, which is done *via* Hodrick-Prescott (HP) filter

[2] GMM framework is suited for samples with large N and small T. Big number of instruments may overfit the IV variables and bias the results.

as suggested by Horvath, Mateju, (2011). The authors suggest that it helps to capture true inflation development as some countries adopted IT as a part of their disinflation strategy. HP filter does nothing but separating cyclical component of the data from long-term trend: $y_t = \tau_t + c_t$, with y_t being the original series, τ_t - the trend component and c_t – the cyclical part.

HP filter removes the trend by solving the following minimization problem:

$$\min_{\tau}\left(\sum_{t=1}^{T}(y_t-\tau_t)^2+\lambda*\sum_{t=2}^{T-1}[(\tau_{t+1}-\tau_t)-(\tau_t-\tau_{t-1})]^2\right) \quad (1)$$

The first term, sum of squared deviations of the original time series from the trend, penalizes the cyclical component (c_t). It is augmented by the sum of squares of the trend second differences premultiplied by λ, on which depends series smoothness. For our analysis we use λ=10, which is suggested by Baxter and King (1999) for annual data. Ultimately we average the detrended series over 3 year periods:

$$\text{Inflation volatility}_t = \sqrt{\frac{1}{3}\sum_{i=t-3}^{t}(\pi_t-\bar{\pi})^2} \quad (2)$$

where π stands for already HP detrended inflation record and $\bar{\pi}$ is average inflation for 3 years periods. When choosing the appropriate number of years we were trying to be consistent with the baseline model specification discussed further, where inflation variable is summed over 3 periods. In addition, we believe that more recent inflation developments matter to a greater extent in policy implications. As a robustness analysis, inflation volatility is calculated as 3 years standard deviation on original series without removing the trend. Analysis is performed on original series taken from the same source: IMF WEO database.

With all the transformations being explained, the baseline model will be estimated using the following equation:

$$y_{it} = \alpha y_{i,t-1} + \beta x_{it} + \delta_t + \gamma_i + \nu_{it}\ , \quad (3)$$

where:

y_{it} – variable of interest (transformed inflation, inflation volatility) for country i=1,2,...,N at time t=1,2,...,T ;

X_{it} – a vector of possible endogenous variables. In our case $X_{it} = \{d_{it}, high_{it}\}$;

d_{it} – dummy variable equal to 1, if country *i* is targeting inflation at time *t*, and equal to 0, otherwise;

$high_{it}$ – dummy variable controlling for high inflation , equal to 1 if inflation is higher than a threshold level of 50%, and equal to 0, otherwise.

$(\delta_t + \gamma_i + \nu_{it})$ – composite error term with

δ_t capturing time fixed effects; γ_i standing for country fixed effects and ν_{it} including the remainder effects.

Inclusion of lagged dependent variable creates an important econometric problem. By construction y_{it} is a function of γ_i and δ_t, therefore $y_{i,t-1}$ is also a function of individual-level and time-level effects. As shown by Nickel, the right-hand side regressor is correlated with the error term, which causes simple OLS estimates to be biased and inconsistent even if ν_{it} is not serially correlated. Even if within estimation in panel data sweeps these effects away,

$$y_{it} - \bar{y}_i = \beta(x_{it} - \bar{x}_i) + (\nu_{it} - \bar{\nu}_i), \quad (4)$$

$\bar{y}_i$ is correlated with $\bar{\nu}_i$ as the average values include lagged variables and $E(y_{i,t-1}\nu_{i,t-1}) \neq 0$. Therefore Least Squares Dummy Variable estimator will also be biased and its consistency will depend upon T being enough large. Random Effects estimator will also be biased due to correlation between transformed dependent variable and disturbance term. Moreover, the bias can be created as well when explanatory variables are correlated with lagged dependent variable. This problem is usually solved by applying Generalized Method of Moments (GMM) estimation proposed by Arellano and Bond (1991). We start with the same initial model, by first-differencing the data we remove individual effects:

$$y_{it} - y_{i,t-1} = \alpha(y_{i,t-1} - y_{i,t-2}) + \beta_2(x_{it} - x_{i,t-1}) + (\nu_{it} - \nu_{i,t-1}) \quad (5)$$

However, there is still correlation between lagged dependent variable and disturbance term which is now a MA(1) process[3].

Arellano and Bond (1991) suggested using all past information as instruments. For the third period we have the following form of the equation:

$$y_{i3} - y_{i2} = \alpha(y_{i2} - y_{i1}) + \beta(x_{i3} - x_{i2}) + (\nu_{i3} - \nu_{i2}) \quad (6)$$

Here we may choose y_{i1} as valid instrument as it is highly correlated with Δy_{i2} and not correlated with $\Delta \nu_{i3}$, assuming that there is no serial autocorrelation in the residuals. Continuing the logic, for t=4, we obtain y_{i1} and y_{i2} as valid instruments for Δy_{i3} and so on, for each following period we are adding one additional instrument. In case we have strictly exogenous regressors x_{it}, then we add them as instruments ($[x_{i1}^T, x_{i2}^T, ..., x_{iT}^T]$)for the first-differentiated equation. If x_{it} is predetermined instead, we add only $[x_{i1}^T, x_{i2}^T, ..., x_{i(s-1)}^T]$ to each diagonal element of the matrix of all instruments (Z_i) as valid instruments for period s[4].

$$Z_i = \begin{bmatrix} [y_{i1}, x^T{}_{i1}, x^T{}_{i2}] & 0 & \cdots & 0 \\ 0 & [y_{i1,} y_{i2}, x^T{}_{i1}, x^T{}_{i2}, x_{i3}^T] & \cdots & \vdots \\ \vdots & 0 & \ddots & 0 \\ 0 & & \cdots & [y_{i1}, ..., (y_{i,T-2}), x_{i1}^T, ..., x_{i.T-1}^T] \end{bmatrix}$$

This technique is known as Arellano-Bond estimator, which generates moment conditions by combing lagged dependent variable and the predetermined variables with first-differences of the disturbances.

However lagged-levels of dependent variables were found to be weak instruments if AR process is highly persistent (Blundell and Bond, 1998). Therefore we give preference to two-step system GMM estimator which

[3] As they contain $y_{i,t-1}$ and $\nu_{i,t-1}$

[4] Necessary condition of strictly exogenous regressors:
$E(x_{it}\nu_{it}) = 0$ for $\forall$ t, s. In case of predetermined variable $E(x_{it}\nu_{it}) \neq 0$ for s > t and 0 otherwise.

imposes an additional orthogonality condition between lagged explanatory variables and levels of disturbances. It is also believed to be better instrumented and capture the highly persistent inflation targeting dummy variable (Bryto, Bystedt, 2008). Finally, by using 2-step finite sample corrected residuals we create a consistent variance-covariance matrix robust to panel-specific autocorrelations and heteroskedasticity.

Besides testing the above discussed model on our original sample we perform sensitivity analysis on a modified one. First, we exclude each geographical group from estimations. Second, we attach to our control group countries from CIS region that satisfy the selection criteria. Additionally, after the dynamic panel estimation we perform several tests. First, we present Arrelano-Bond test for autocorrelations applied to first-differenced residuals. Usually the test for AR(1) process is expected to reject the null of no autocorrelations; the AR(2) test is of higher interest for us, since it detects autocorrelation in levels. Next, Hansen J test assesses the overall validity of applied instruments, and difference-in-Hansen statistics valuates exogeneity of additional moment conditions. Failure to reject the last two is an argument in favour of the proposed model.

Next we explicitly present equations for testing of our hypotheses. The first one will be assessed by:

$$y_{it} = \alpha y_{i,t-1} + \beta d_{it} + \varphi high_{it} + \delta_t + \gamma_i + \nu_{it} \quad (7)$$

We are interested in the sign and significance of the coefficient β. Following our hypothesis of IT countries experiencing lower inflation and inflation volatility on average compared to control group, β is expected to be significant and negative. In case when there is only mean reversion process found in Ball and Sheridan (2005), only α will be significant indicating an AR(1) process whose stationarity will depend upon the absolute value of the coefficient[5].

[5] Necessary and sufficient condition for AR(1) to be weakly stationary is |α|<1 (Wooldridge,5th edition, pag.368-372);

In order to test if our hypotheses hold for the period during the crisis we introduce an interaction variable between inflation targeting dummy and crisis, so that our new model has the form:

$$y_{it} = \lambda_0 + \alpha y_{i,t-1} + \beta * d_{it} * crisis_t + \varphi high_{it} + \delta_t + \gamma_i + v_{it} \quad (8)$$

where $crisis_t$ is a new dummy variable indicating whether time period is incorporating the crisis (i.e equal to 1 from 2007Y onwards). Coefficient β captures the interaction of crisis proxy with inflation targeting dummy thus isolating the effect of the analyzed regime only for the period of the recent financial turndown, keeping other factors constant. Taking into account the findings of Carvalho Filho (2011) that inflation targeting framework has helped countries to avoid deflationary trap and zero lower bound on policy rates, β is expected to be less negative. In this paper we attempt to test if it holds for emerging and developing economies.

When testing our next hypothesis regarding contrasting performance of the regime in different geographical regions[6] we propose the OLS equation:

$$y_t = \lambda_0 + \alpha y_{t-1} + \theta_1 * d_t * CEE + \theta_2 * d_t * ASIA + \theta_3 * d_t * LATAM + \\ + \theta_4 * d_t * AFRICA + \varphi high_t + e_t \quad (9)$$

In order to capture regional differences in performance between inflation targeting countries we create interaction variables between two dummies, one is IT dummy and the other is responsible for regions tabulation[7]. Ultimately coefficient θ_1 will represent the effect of the framework in CEE countries keeping other factors constant. The same logic applies to θ_2, θ_3, θ_4 that are incorporating the effect of inflation performance in Asia, Latin America and Africa respectively. The rest of the world with other regimes is captured in the constant term (λ_0). For consistency we still control for mean reversion and high inflation. We expect region coefficients to be negative to reflect monetary policy

[6] Regions were distinguished according to IMF WEO classification.

[7] i.e CEE=1 if region is Central and Eastern Europe and equals to 0 otherwise, ASIA=1 if region is Developing Asia and equals to 0 otherwise, LATAM=1 if region is Latin America and Caribbean and equals to 0 otherwise and AFRICA =1 if region is Sub-Saharan Africa and equals to 0 otherwise.

effectiveness. Any significant differences in absolute value of the coefficients will reflect the fact that a particular region has a better regime performance over analysed timeframe.

We start our estimation by simple pooled cross-section OLS adding consequently time (TE-OLS) and country fixed effects (CTE-OLS) thus accounting for individual heterogeneity across countries (time invariant countries' specific shocks and developments) as well as for time patterns common to overall sample (periods of high inflation or other imbalances that were perceived globally). For this purpose, dummy variables both for time and country effects are created and all but one are included into regression. Further we present the results of difference GMM estimation when treating inflation targeting dummy as predetermined. Next we present two specifications of system GMM framework, first by assuming that inflation targeting is predetermined and then, accounting for Gertler's (2005) and Mishkin and Schmidt-Hebbel's (2002) critique, we treat the mentioned variable as endogenous. Presentation of all the specifications will allow us to better understand the dynamics of the results as model is adapted to potential identification problems.

2.3 Empirical Findings

The estimation results of the equation (8) performed on a panel of 43 emerging and developing countries for a period from 1997 to 2011 are presented in the next table:

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Table 2.1: Estimates of Inflation Targeting on Inflation and Inflation Volatility

1.A Dependent variable**: CPI inflation** (y-o-y change)						
	OLS	TE-OLS	CTE-OLS	D-GMM	S-GMM(p)	S-GMM(e)
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
IT dummy	-5,07***	-5,46***	0,94	11,66	-4,84	-5,60**
	(1,49)	*(1,46)*	*(5,11)*	*(25,17)*	*(2,88)*	*(2,62*)
Lagged inflation	0,41***	0,41***	0,29***	0,11	0,18*	0,34***
	(0,10)	*(0,10)*	*(0,66)*	*(0,14)*	*(0,09)*	*(0,04)*
HIGH inflation dummy	63,14***	64,48***	90,57***	159,56***	141,37***	79,79***
	(29,35)	*(19,68)*	*(13,16)*	*(45,89)*	*(40,24)*	*(14,84)*
AR(1)test				0,20	0,19	0,08
AR(2)test				0,38	0,34	0,33
Hansen J test				0,23	0,46	0,53
Diff.-in-Hansen					0,95	0,97
Instrum.				24	34	33
Observ.	171	171	171	128	171	171
R^2	0,73	0,74	0,71			
1.B Dependent variable**: inflation volatility**						
IT dummy	-0,82*	-0,83*	2,21*	-5,02	-0,74***	-0,73**
	(0,44)	*(0,43)*	*(1,16)*	*(0,78)*	*(0,27)*	*(0,32)*
Lagged inflation volatility	0,26	0,26	0,17*	0,53	0,42	0,24**
	(0,21)	*(0,21)*	*(0,10)*	*(0,43)*	*(0,26)*	*(0,11)*
HIGH inflation dummy	16,34**	16,05*	18,65**	-1,76	1,43	17,19**
	(8,12)	*(8,17)*	*(7,16)*	*(26,44)*	*(17,67)*	*(7,26)*
AR(1)test				0,14	0,13	0,17
AR(2)test				0,24	0,17	0,19
Hansen J test				0,54	0,96	0,90
Diff.-in-Hansen					1,00	0,86
Instrum.				24	34	33
Observ.	171	171	171	128	171	171
R^2	0,52	0,52	0,45			

Note: * statistically significant at 10% level, ** statistically significant at 5% level, *** statistically significant at 1% level. CPI inflation is transformed: $y_{i,t} = 100*\ln(1+CPI_{i,t}/100)$and summed over 3 years. Inflation volatility is proxied by standard deviation of HP detrended CPI over 3 years. Column (1) includes pooled cross-sections OLS, in (2) and (3) time-fixed effect (TE-OLS) and country fixed-effect (CTE-OLS) are added respectively. Robust standard errors clustered by country are presented in paranthesis. Column (4) depicts two-step Arrelano-Bond difference GMM estimator. Next 2 columns make use of two-step system-GMM estimator which

takes inflation targeting dummy as predetermined (5) and as endogenous variable (6). Two-step robust standard errors corrected for finite sample are presented in paranthesis. AR(1), AR(2), Hansen J test and Difference-in-Hansen test report the respective p-values.

Column 1 in table 2.1 shows the result of pooled cross-sections OLS without country and time fixed effects with robust standard errors. The estimates are consistent with our expectations that inflation targeting has helped to reduce average inflation (almost by 5 percent, panel 1.A) as well as inflation volatility (by 83 basis points, panel 1.B) and with existing studies of Batini et al. (2006), Lin and Ye (2008), Gemayel et al. (2011) although with different absolute values on inflation reduction. Lagged inflation contributes little to explaining present level of inflation, the respective coefficient being smaller than 1 % in both specifications, which contrasts Ball and Sheridan's reversion to the mean explanation. The dummy for high inflation is significant for both measures of economic performance, indicating that in high inflation periods we can observe higher volatility of the variable.

The inclusion of time effects in the estimation (column 2) does not significantly modify the results similarly to Bryto and Bystedt (2008) findings. The only noticeable change we can observe is that coefficient on inflation targeting dummy reduction increases by 40 basis points suggesting that omission of time dummies understates the true relation between inflation targeting and level of inflation. Inflation volatility reduction remains practically the same, although smaller in absolute value than estimates of Batini et al. (2006) and Gemayel et al. (2011).

Column 3 depicts the results for 2 way error component model for panel data with country and time fixed effects and robust standard errors clustered by country. As it was mentioned earlier, inclusion of lagged inflation in the model biases the results as it creates correlation between dependent variable and the error term. Hence, we obtained positive although not very insignificant impact of IT regime on inflation and inflation volatility. The coefficients of lagged and high inflation remain significant although differing in absolute value compared to previous specifications.

In the next column we employ two-step difference GMM estimation by treating IT dummy as predetermined and accounting for endogeneity of $high_{it.}$ Similar to Bryto and Bystedt (2008) for periods t≥3, we take $(y_{n,t-2-j}; d_{n,t-1-j}; high_{n,t-2-j})$ for j=0, 1,..., t-3 as available instruments. We still include time dummies for consistency of the estimation. There is no sign of first or second order autocorrelation in the residuals and Hansen statistics does not allow us to reject the overall validity of the model. Nevertheless, the estimation results are not supporting our hypothesis. The IT coefficient is positive and insignificant for average inflation equation and negative but still insignificant for inflation volatility specification. The uncertain results of this model specification may be a sign of weak validity of past levels of inflation to be appropriate instruments for its present behaviour. The latter creates a necessity to apply system GMM estimator, given an additional fact of high persistence of IT dummy variable.

The next two columns exhibit coefficients obtained after two-step system GMM estimation with robust standard errors corrected for finite sample. In column 5 we treat d_{it} as predetermined and $high_{it}$ as endogenous variable. Like in column 4, for t≥3, we have instruments $(y_{n,t-2-j}; d_{n,t-1-j}; high_{n,t-2-j})$ for j=0, 1,...,t-3 for equation in differences and $(\Delta y_{n,t-1}; \Delta d_{n,t}; \Delta high_{n,t-1})$ for equation in levels. Now we obtain a negative sign of IT coefficient on average inflation which, however, lacks statistical significance. In case of inflation volatility it is smaller by 9 basis points than in OLS estimation and significant at 99% confidence level. In both specifications there is no serial autocorrelation in the differenced residuals and Hansen and difference-in-Hansen tests assess the overall validity of the instruments used.

Finally, in column 6 we account for potential endogeneity of IT adoption discussed earlier by addressing inflation targeting proxy as endogenous variable and high inflation dummy as predetermined. In this case for t≥3, we have instruments $(y_{n,t-2-j}; d_{n,t-2-j}; high_{n,t-1-j})$ for j=0, 1,...,t-3 for equation in differences and $(\Delta y_{n,t-1}; \Delta d_{n,t-1}; \Delta high_{n,t})$ for equation in levels. The obtained results are more negative than in all previous specifications and in line with our

hypothesis. With 95% confidence we can say that inflation targeting regime caused diminishing of inflation by 5,6 percent per year more relative to countries with other monetary policy frameworks. The result is consistent, although higher in absolute value, with Batini et al.(2006) and Gemayel et al. (2011) findings for emerging economies. There is a sign of first-order autocorrelation and no evidence of second-order dependence in the residuals. Moreover, we do not reject the Hansen's test null of exogeneity of applied instruments as well as the validity of additional instruments examined by difference-in-Hansen statistics, which makes us to believe that model was correctly specified. Similar to Brito and Bystedt (2008), the estimates for inflation volatility do not change relative to previous specification, revealing the fact that the main source of the bias was coming from reverse causality between inflation targeting and average inflation. So far, IT regime favoured inflation volatility reduction by 73 basis points, which is relatively small compared to Batini et al. (2006) estimates of 3,6 percent.

Thus, accounting for potential reverse causality of IT adoption and country and time fixed effects we supported our hypothesis of the effectiveness of the regime on an unbalanced panel of 43 emerging and developing countries over the period of 1997-2011. We check the sensitivity of our results by modifying our sample of countries. First, we include a group of CIS countries in the control group and then, we exclude each region of the world from the sample. The results (presented in table A.5, appendix A) preponderantly support our baseline findings of positive effect of inflation targeting regime on disinflation even when accounting for potential endogeneity. The β coefficients are significantly in line with previous findings and in some cases even more negative than before. Additionally, we check our measure of volatility, by applying the same model on a series without having detrending it (table A.7, appendix A). We obtained practically the same parameter estimations in new specification meaning that effect of IT on inflation volatility is robust to our initial specification.

Next, in order to test if inflation targeting impact on inflation and inflation volatility holds during the crisis period, we just add an interaction variable between inflation targeting proxy and new time dummy responsible for crisis period. Then, we apply the previously mentioned models with analogous assumptions and instruments for dynamic panel, which results can be found in appendix A, table A.4.

Notably, we discovered negative impact of the regime on inflation in all 6 empirical specifications. Our main finding is that during the crisis period the difference in average inflation between IT and NIT countries remained to be around 5 percentage points being significant at 95 percent confidence interval. The absolute value of the coefficient lies between TE-OLS and CTE-OLS revealing the signs of the biases. The Arellano-Bond tests exposes signs of first order autocorrelation in differenced residuals and no autocorrelation of the second order. High p-value of the Hansen and difference-in-Hansen tests does not allow us to reject the overall validity of the instruments. Interestingly, the absolute value of the coefficients of interest (column 5 and column 6) is almost similar to results from table 2.1. In further estimation we tried to test the model with d_{it} and d_{it}*$crisis$ interaction dummies together, thus isolating the IT effect in the crisis while controlling for normal times IT influence. Following this logic, the model will take the form:

$$y_{it} = \lambda_0 + \alpha y_{i,t-1} + \beta_1 * d_{it} + \beta_2 * d_{it} * crisis_t + \varphi high_{it} + \delta_t + \gamma_i + v_{it} \quad (10)$$

Thus β_1 incorporates "normal effect" of the regime, while β_2 outlines what was different in the crisis time in terms of IT impact. The estimated results can be found in table A.6, appendix A.

Overall, the depicted coefficients are less negative, although they lack statistical meaning. This suggests that there is a lot of multicolinearity between IT dummy and its interaction with the crisis proxy. We assume that it may be explained by the fact that most of the countries employed in our analysis have adopted IT quite recently, which is often the case for emerging and developing economies. This would also explain why the results in table 2.1 and table A.4 are very similar.

Nevertheless, our results for inflation volatility (panel 2B, table A.6 and table A.4, Appendix A) in system-GMM framework are consistent with findings of Fouejieu (2012), and namely the variability of inflation was smaller by almost 1% in inflation targeting countries, proving that the magnitude of inflation changes was less sensed by targeting countries probably because of higher credibility and anchored inflation expectations that rendered targeting central banks with more flexibility in response to the external shocks. The estimate coefficient of interaction is significant at 10%. IT dummy takes opposite sign but it lacks statistical certainty. Lagged inflation volatility and high inflation proxy take similar values as in table A.4. Therefore we are not able to tell with confidence if the regime performance differs for the pre-crisis and crisis periods in selected sample of 43 emerging and developing economies.

As for our next hypothesis regarding IT performance in different regions we obtained the following results:

Table 2.2: Estimates of Inflation Targeting on Inflation in Different Regions of the World. Dependent variable: **CPI inflation** (y-o-y change).

Variable	**Estimates**
CEE*d	-5,51***
	(1,52)
ASIA*d	-5,26**
	(2,46)
LATAM*d	-5,23***
	(1,75)
AFRICA*d	-2,45
	(3,32)
Lagged Inflation	0,41***
	(0,10)
High inflation dummy	63,10***
	(19,50)
const.	12,04***
	(2,87)
R^2	0.73
Observations	171

Note: * statistically significant at 10% level, ** statistically significant at 5% level, *** statistically significant at 1% level. CPI inflation is transformed: $y_{i,t} = 100*\ln(1+CPI_{i,t}/100)$and summed over 3 years. Robust standard errors are presented in paranthesis.

Basically, the sign of the coefficients responsible for region's IT performance are consistent with baseline model findings. Almost all regions have reliable negative responses that show average inflation lowering of 5 percentage points. We did not find a substantial discrepancy in absolute values of the estimates that allows us to believe that a particular region obtained higher inflation reduction. Although African countries are exception from the last observation, its coefficient is statistically not valid. It is probably due to the fact that we have only two targeting countries within African region in our sample, which appears to be insufficient for determining the average group impact.

CHAPTER 3

Conclusions

Popularity of IT regime among emerging markets has been constantly increasing recently. Nevertheless, it did not settle down the existing disputes on whether targeting choice is argumented. Additionally, the recent financial crisis has reconsidered the argument of a too limited objective of the regime. The present part of the paper has attempted to provide an empirically argumented basis on the existing conflict. Giving the fact that there is a relatively low number of studies that focus on developing economies, we decided to include them in our analysis.

The first part of this thesis is focused on IT perfomance in emerging and developing economies. We start by discussing the current state of the literature concerning IT performance delimiting between the normal and crisis times. The ambiguity of the existing works has motivated us to perform our own analysis of the regime effectiveness taking into account potential biases of previous studies. Therefore, we employ dynamic panel estimators to control for reverse causality of IT adoption frequently discussed by regime opponents, and investigate policy impact on lowering inflation and inflation volatiliy in both normal and crisis times.

Overall, our results support the regime effectiveness. After controling for potential endogeneity, mean reversion and for the persistence of high inflation we obtained negative parameter estimates of IT dummy on both inflation and volatility of inflation. Our results on inflation reduction are robust to modification in both treatment and control groups. On the one hand, the estimated coefficient for inflation reduction (5,6%) is slightly higher in absolute value than in most previous studies which support the regime. On the other hand we obtained a comparatively lower coefficient (73 basis points) for

volatility reduction caused by IT. We believe it may be a consequence of inclusion of a big number of developing coutries in our sample that might have had a much stronger effect of the regime. These findings are robust to modifications in both the control group of non-IT and in the treatment group of IT countries.

However, the ultimate impact of IT on the selected sample of countries during the turmoil periods is undeterminable. The estimated parameters on disinflation and its volatility were similar to previous model findings, but we could not differentiate the crisis period influence from the ”normal times” due to relatively short time from the regime adoption by most developing countries from our sample, that creates high collinearity between the analysed variables.

When it comes to our second hypothesis, according to our empirical results, there is no significant difference in absolute value of IT performance among different regions of the world. Moreover the values of the estimated parameters were mostly in line with baseline model specification. Exception was represented by the group of African countries for which we obtained insignificant coefficient. However, we believe it is caused by a relatively small number of currently targeting African economies included in a treatment group that might have had insufficient explanatory power.

Despite the broad arguments addresing IT ineffectiveness, our results support the regime and imply that shifting to IT will lower both inflation and inflation volatility. One might argue that these promising results are subject to several caveats. First, the inclusion in a sample of both emerging and developing economies makes it difficult to distinct the findings between the economies. However, we believe initial country selection criteria of simalar macroeconomic performance allows us to generalize the results. Second, most of the countries did not reach a stationary target and therefore, the results can serve rather as a short and medium run effect. Third, when claiming our conclusions we did not account for a potential macroeconomic cost at which IT effectiveness could have come. Therefore, an interestng question for further research would be the reaction of other variables and particularly, if disinflation comes at a price of

higher trade-off with regard to output. Finally, as stated in Gemayel et al. (2011), IT causality on inflation reduction in low-income countires is difficult to fully assess as it may be partially influenced by another factors such as structural and policy reforms that comes together with targeting decision.

In the second part we considered the IT framework's applicability to a particular developing country - Republic of Moldova. We provide insights into National Bank of Moldova monetary policy, develop an analytical basis of IT preconditions meeting, as well as make a monetary transmission mechanism approximation by VAR modeling.

PART II

Case Study on the Developing Economy: Inflation Targeting Preliminary Experience of the Republic of Moldova.

The second part of the work focuses on the Republic of Moldova IT regime behavior within its starting steps. We begin in Chapter 4 by describing the experience of inflation targeting for some developing countries, and then we discuss the National Bank of Moldova policy implementation framework and first realizations of the IT regime. Next we make in Chapter 5 an attempt to analyze operating transmission mechanism of available monetary policy tools using Vector Autoregression models. The second part ends in Chapter 6 with an overall synthesis of the IT framework and further policy recommendations for improvement.

CHAPTER 4

Inflation Targeting in Moldova

4.1 Emerging of IT in Some Developing Economies

Usually developing countries experience difficulties in implementing both institutional conditions (Masson, Savastano, Sharma, (1997)) and technical ones (Eichengreen et al., 1999). Although in past it was considered a necessity to fulfil these requirements for a successful framework implementation, some countries did not fully correspond and still made progress in achieving the main goal of price stability. Moreover it generated a view that the fully meeting of

these conditions is not a must as countries converge to them gradually after the adoption (Batini and Laxton, 2006). Further, we present initial experience of several countries.

Turkey experience with IT is described by Kara (2006). The country officially adopted IT in 2006 after a smooth transition from an exchange rate peg. Weak initial conditions, high fiscal dominance, sensitivity of government debt to exchange rate shocks, low central bank independence, uncertain transmission mechanism motivated monetary authorities to start with an intermediate regime with the basic ingredients of the IT, in which the country started developing institutional capacity necessary for framework implementation. The outcome of the transitory regime outpaced the expectations; inflation was lowered from significantly high levels to single digit numbers, inflation expectations were anchored, CBT obtained independence, imposing of fiscal discipline and cooperation with government policies was seen as a good sign and helped to gain credibility from the public. As a conclusion Kara (2006) underlines policy support, institutional independence and commitment to floating ER regime as the main factors of successful implementation of the regime in Turkish economy.

Bank of Albania officially adopted IT in 2009 after 5 years of preparations. Since 1992, stable macroeconomic situation and low inflation environment, catalyzed economic growth and placed the country in a more favourable position than other transitional countries (Gemayel et al., 2011). Luci and Ibrahimi (2007) mention that problems with IT adoption in Albania are to a greater extent technical rather than institutional, as the Bank of Albania has already been granted independence and has price stability as its main objective. Hence, the main impediments seem to be building a macroeconomic model for the economy with clear transmission mechanism and good forecasting power and establishing efficient communication with the economic agents.

Ghana was the second country in Africa to officially adopt IT framework in 2007. Following the experience of other countries it started with several years of preparations aimed at creating stable environment, achieving policy

instruments independence, building transparency. Gemayel et al. (2011) notice that since the framework adoption country never hit the targeted range of 5 p.p. +/-1 p.p. because of global food and oil shocks, expansionary fiscal policy, and negative interest rates that had created inflationary pressures at the time of regime adoption. So far, country still needs to make progress in financial sector stabilization, improve communication and transparency and not least, to anchor inflation expectations.

4.2 Issues on IT adoption in Moldova

The National Bank of Moldova (NBM hereafter) has a history of more than 20 years, starting in 1991 after the country has obtained independence. Its autonomy and independence is granted by law and the primary objective is achieving and maintaining price stability. Without prejudice to main prerogative of creating a low-inflation environment, NBM needs to support Government policies aimed at sustainable economic growth and employment of the population.

The idea to target inflation appeared in 2008 and was considered as the most suitable framework for attaining the main policy objective of price stability in the context of available policy instruments, current economic environment and successful experience of other countries. After 2 years of preparations the IT was adopted by the Bank Board (Council of Administration) as official monetary policy regime pursued by NBM. It is worth mentioning that before 2010 the NBM practiced floating exchange rate regime with clearly stated aim of stable prices. Even though IT assumes pure floating, NBM reserves the right to intervene in foreign exchange market without having any particular exchange rate objective and in case it is not undermining its primary goal of price stability. Regime adoption came altogether with substantial banking environment legal framework modifications and namely with amendments and corrections to the Law on financial institutions (nr.550 of 21.07.1995) and Law on guaranteeing deposits of individuals in the banking system (nr.575 of

26.12.2003) aimed at creating of a new banking supervising entity and of a National Committee for Financial Stability.

The basic prerequisites for IT adoption argued by Masson et al. (1997) are Central Bank *independence* and *primacy of inflation objective*. The first precondition of conducting a monetary policy separately from other policies is granted by law on the NBM, which grants monetary authority autonomy and independence from political influence and prohibits the bank from financing the Government and other institutions. However a high budget deficit (existing even at the time of adoption) and superficial capital markets may create premises of fiscal dominance and undermine the Central Bank's reputation and overall effectiveness of pursued monetary policy. The second precondition of no firm commitment to target other nominal variable is stipulated in law and in the medium term strategy of the NBM stating that other objectives are followed only in case they do not affect the price stability. The same authors mention that for achieving better effectiveness and stronger consistency, monetary authority should create a favorable environment consisting of several important elements:

i. Stated quantitative target for future inflation

The explicit target of the NBM is 5 p.p with the variation interval of +/- 1.5 p.p applied on annual CPI change. The CPI was selected as targeted inflation index in the first place because it is historically perceived by the public, it is not subject to reviews being available in due time. Not least, it preserves the principle of separation of interests between the institution that collects the data and estimates the index and institution that has inflation as main policy objective. The targeted number is supposed to gradually diminish over time as inflation expectations are better anchored and reputation is established. The target is maintained using main policy instrument – rate for the open market operations and complementary policy tools – standing facilities, required reserves ratio and foreign exchange interventions.

ii. Existence of methodological framework for producing veridical forecasts

The information about applied forecasting models is not published officially. Even though the Monetary policy strategy for medium-term (2012) mentions that econometric models are under a continuous development, they face a lot of challenges represented by poor methodological knowledge, adjustment of the agents to the new regime and lack of the historical data necessary to analyze the effectiveness of propagation mechanism. Nevertheless the bank has the ultimate goal of establishing the interest rate channel as the prevalent one for monetary, foreign exchange and credit markets dynamics.

iii. Forward-looking operating procedure

The NBM adjusts its policy instruments in line with the deviations of the forecasted inflation and the targeted one. Even so economic agents still need to be educated as they form their expectations in backward-looking manner. These completely opposing orientations may create problems in monetary transmission and overall effectiveness of the NBM actions.

4.3 Preliminary Achievements of the IT Regime

The first realizations of the regime were published in the Report on Monetary Policy Medium-term Strategy (2012). It mentions the next accomplishments of the IT framework during 2 years of implementation:

- Gradual lowering of annual inflation rate to single digit levels, which was double digits 19 year in a row before 2010. However, the targeted interval of 5p.p. +/- 1.5p.p. was hit only in the last 3 month of 2012. As a result the disinflationary process was consolidated and *inflation expectations were anchored* under 10 percent level as stated by the NBM in the report on monetary policy.
- Building and maintaining the *transparency* was one of the main goals along the period of implementation of the regime. It was materialized through an increased and continuous communication with the public

aimed at reducing informational asymmetries and increasing the predictability of monetary actions. The NBM started publishing monthly press-releases of Board decisions including voting of the Board members (with a 6 month delay) and quarterly inflation reports, which as a result has increased credibility and reputation of the bank to the public. However when it comes to forecasting model used by the bank staff, it is neither published nor explained. This uncertainty may undermine the transparency and overall transmission mechanism of the monetary policy.

- Enhancing *accountability* to the Parliament and economic agents through public hearings and participation in parliamentary sessions dedicated to monetary policy analysis. The targeted inflation is explicitly stated and the reasons why it was or was not hit are properly explained in quarterly inflation reports. In the latter case the monetary authority is also in charge of explaining the future steps to correct the deviations. Moreover, the central bank organizes with quarterly frequency press conferences with the participation of the governor of the bank and other staff members, who give insights to current macroeconomic conditions and prospects of the external environment.

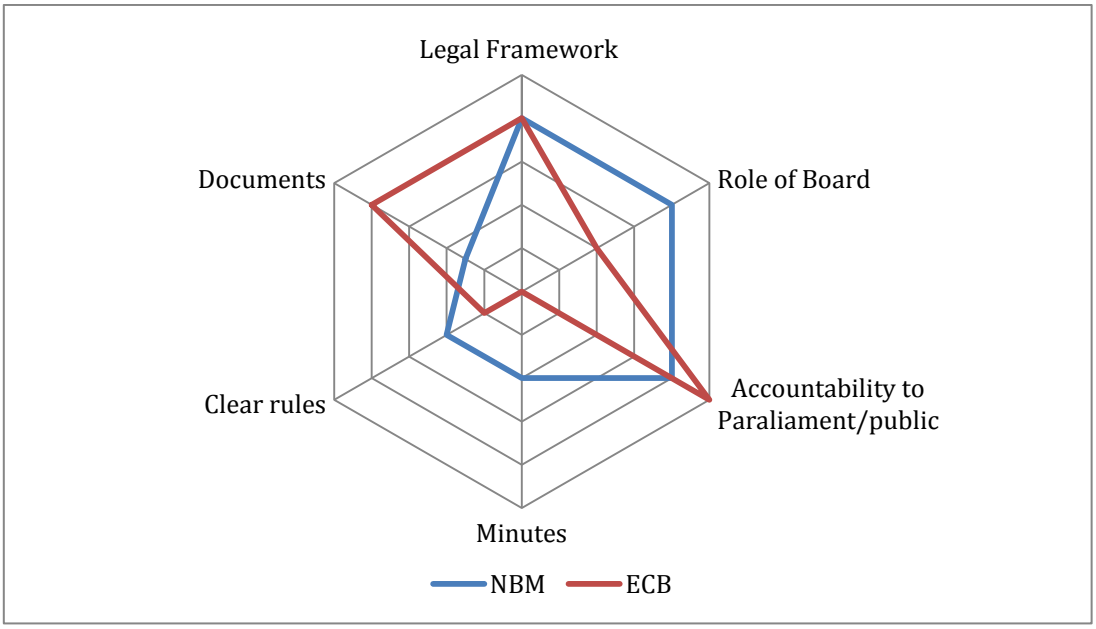
The policy pursued by the NBM puts a strong emphasis on convincing the public that inflation is the main objective of the monetary actions and not other nominal variable. However, foreign exchange (FX) interventions have been quite common practice by the bank especially during the recent crisis as they were considered to be more effective in achieving the trade-off between inflation and output. It is worth mentioning that in case of the Czech National Bank FX interventions, this outcome was found significant only within short-term horizon (Gersl and Holub, 2006). What is more important; the authors consider that it may come at a price of undermining central bank credibility in case of potential inconsistency of intervention with IT framework.

Even though there is much space left for improvement, the NBM has achieved important accomplishments relatively in a short time span starting to

build good reputation and gain credibility from the public, which is one of the main requirements for successful IT implementation

Next we will quantify the NBM framework into a web chart in order to have a better understanding of its current state of functioning. We select several criteria proposed by Smidkova and Tuma (1999) applied at analyzing the main institutional players: Federal Reserve System, European Central Bank, Bundesbank and Bank of England. The qualitative information we have on the NBM is quantified into numbers in a way that the higher the number is the better it matches the criteria of effective functioning. As a benchmark we also include the ECB framework quantification provided by above mentioned authors. It must be noticed that this little evaluation represents strictly subjective opinion of the author formed within the analysis and may not fully correspond to the NBM vision.

Figure 4.1: The NBM and benchmark frameworks



Source: ECB evaluation taken from Smidkova, Tuma (1999). NBM-own evaluation based on presented criteria.

1. **Legal framework (4p).** The NBM is an autonomous public entity responsible to the Parliament. Similarly to the ECB, independence is granted by law which also interdicts the bank to finance the debt coming from Government and other public institutions.

2. **Role of Board (4p).** The NBM board consists of 5 members independently named by the Parliament for the period of 7 years with the possibility of prolonging the contract. Role and responsibilities of the Board are established by law. The Council is responsible for the main operations: policy rates setting, reports approval, monetary supply, issuance of debt securities and licenses, determining the operational and structural framework of the bank. In case of our benchmark framework, the ECB, which is more likely a federal system with 6 core and national representatives. The role of the Executive Board is limited to monetary policy implementation in accordance with guidelines and decisions of another decision making body - the General Council. Interruptible contracts of members of a Board valid over 8 years horizon together with strong position of national banks weakens core management body.
3. **Accountability (4p.).** Similarly to the ECB, the NBM is directly accountable to the Pariament and public informing them periodically about main macroeconomic perspectives, the evolution of the financial markets, monetary supply, crediting, balance of payments and the state of the foreign exchange market (law on the NBM). Mishiting of the target and future corrections are properly explained in inflation reports and press releases and conferences organized by the monetary authorities. However, there is no specified contract for the case of errors.
4. **Minutes (2p)** on basic policy decisions are published within central bank's monthly press releases. They are released the same day after the Board meeting and contain brief and succinct information regarding decisions on main policy instruments as well as on premises and reasons that led to a particular decision. However the names and voting pattern is known with a delay of 6 months. Additionally quarterly press-conferences are organized to inform the economic agents about current state of the main macroeconomic and financial indicators as well as future prospects and forecasts. Noticeably, the ECB publishes neither

minutes nor voting patterns, divulging information concerned only with the staff' forecasts.

5. **Clear rules (2p.).** Although the aimed level of infaltion is explicitly stated each period, the rules of the game are not always obvious, being distorted by resistance of the NBM to allow more exchange rate flexibility thus sending unclear signals about policy intentions to the market (Gigineishvili, 2007), which cannot derive implicitly the target from the knowledge of the economy and published forecasts. Monetary transmission mechanism is also subject to uncertainty and opaqueness. However, we see the NBM rules of the games more clear in comparison with the ECB dual strategy (inflation and money).
6. **Documents (1.5p)** that are periodically published by Moldavian monetary authority exhibit high attention to explanatory part of the main strategy and performed actions but stress to a lesser extent technical details, which introduces some degree of uncertainty about their trustworthiness. Even though, released information reveals forecasts of the main macroeconomic indicators, when compared with the ECB high quality forward-looking documents, we assess a strong need for further improvement in the quality of presentation of the relevant information by the NBM.

As can be noticed from the figure above, the analyzed monetary regime encounters problems in technical aspects rather than in institutional ones. Given the fact that the policy aims to fix inflation expectations it is of great importance to have a developed infrastructure and attract competent specialists able to perform efficient forecasting and analysis of future developments of the economy capturing the specifics of monetary policy transmission. Therefore, the NBM should focus on fixing the issues of accountability and transparency and generate some actions aimed at building reputation and improving monetary policy long term performance.

CHAPTER 5

Analysis of the Monetary Transmission Mechanism of the Moldavian Economy

5.1 Theoretical Approach to Monetary Policy Transmission

As it was already stated in IT framework monetary authorities affect prices by changing policy interest rates. But how exactly these changes in instruments affect the economy? The answer to this question is a very complex transmission process consisting of numerous stages and distinct channels that very often interact and reinforce each other. The theory addresses 3 visions of monetary transmission and namely: traditional, credit channel and supply-side view. Traditional view describes the impact of interest rate change on aggregate demand; credit channel view emphasizes the same effect on the demand and supply in the credit market and finally, supply-side vision stresses the reaction of real economy supply to modifications in policy instruments. These interactions with the economic variables are done through 4 basic transmission mechanisms that are described below in more detail selected from Mishkin (1995).

- *Interest rate channel* describes a direct influence of nominal rates on real rates considering price rigidities in small time horizon. Therefore a monetary policy contraction will have a consequence of reducing private consumption and investment due to interest rate pass-through to lending rates with changes in present value of consumption and higher costs of credit. Moreover it can affect the risk of asymmetric information together with high moral hazard and big probability of adverse selection

and result in lowering of the overall supply of credits. Altogether it will directly influence the aggregate output, the impact being more prominent in bank dependent economies with embryonic capital markets and no alternative source of financing, which is the case of developing markets.

- *Asset-price channel* reinforces interest rate channel especially in countries with developed capital markets. Hence expansionary monetary policy can lead to increase in asset prices and balance sheet restructuring. Furthermore, banks will offer cheap credits, firms will increase investments and households will raise consumption which will positively alter the output. At the same time economic agents will seek to decrease the surplus of liquidity by investing it in equity and bonds inducing their prices to raise further, which potentially may create price bubbles. The latter situation will require prompt actions from the monetary authority.
- *The exchange rate channel* is argued to be of greater importance for economies in transition than for industrialized countries due to smaller dimensions and larger openness of the former, which have a big share of imported goods (Campa, Goldberg, 2002). Hence, monetary contraction is followed by domestic currency appreciation and lower inflation. Meanwhile, lower exchange rate of national currency decreases net export affecting the output gap in the same direction and relaxes the pressure on prices.
- *Expectations channel* is probably most visibly linked to IT framework since it aims at anchoring expectations. Furthermore, a sudden worsening of Central Bank's credibility accompanied by increase in inflation expectations may result in bigger aggregate demand and higher output gap. As a result prices will also increase in the long run when output will be returning to its potential level.

Several facts are worth mentioning. First, channels can have different relevance for a particular economy. While exchange rate channel play an extremely

important role for developing countries, asset-price channel may lack relevance in these economies as they usually have underdeveloped capital markets. Second, transmission is done with a lag, which may vary across countries. However, as country's economic situation develops over time, the lengths of transmission also adjusts.

Forward-looking monetary policy decisions assumed by IT framework stress a great importance of preliminary knowledge of the speed and the extent of adjustment of inflation and real economy to changes in Central Bank's instruments. Therefore, analyzing monetary transmission mechanism aspect of Moldavian economy can help us to draw a clearer picture of the actual situation and elaborate on future developments. In the following sections we will try to answer the question, which of the available instruments used by the NBM have stronger effects on prices: main policy rate, required reserve ratio or exchange rate; and what is the speed of adjustment of the variables to simulated monetary shocks.

To our best knowledge we have noticed that Moldova lacks studies focusing on monetary transmission analysis. One of the few authors was Gigineishvili (2007) who tried to examine interest rate channel of monetary policy propagation in Moldova by approximating the strength and speed of interest rate pass-through. His results were not encouraging; the NBM modification of the main policy rates has weak and almost ineffective propagation both to market and to retail rates being caused by primitive development of financial markets, incomplete term structure of the instruments, excessive liquidity pumped into the market, all these leading to inconsistency of policy actions with its long-term goals, distortion of the yield curve and to lost credibility of the monetary authority.

Next, Gorbanyov et al. (2010) have analyzed Moldavian monetary transmission mechanism *via* VAR framework with different specifications. Their main findings can be resumed to: first, monetary policy instruments have incomplete effect on market and retail rates. Second, there is no significant relationship between GDP growth and main policy rate, the latter rather affects

private credit and prices. Finally, they came out with very persistent although not very significant result that currency depreciation leads to higher inflation.

Finally, Lupusor, Babin and Popa (2012) using structural VAR estimation came to the conclusion that main contribution to weakening of monetary sector efficiency is given by such factors as domestic and foreign fluctuations of industrial sector. Thus a shock to industrial production index induces almost unitary persistent response of inflation with a delay. Also, the required reserve ratio is responsible for much stronger movements in inflation than main policy rate. However too often resorting to this policy tool is inadvisable since it manifests adverse shocks over the lending activity of the banking sector.

5.2 Data Selection

Next we will analyze transmission mechanism of the NBM monetary policy using Vector Autoregression (VAR) framework firstly proposed by Sims in 1980. It is nothing but a system of equations regressed on each other's lag. The VAR framework will include the following variables in levels taken in the specified order:

- Real GDP [*l_gdp*] will proxy economic activity. Quarterly series were log-linearized and seasonally adjusted. In order to obtain monthly frequency we interpolated quarterly observations using quadratic-match average procedure as seen in Borys, Horvath (2008).
- CPI index (*l_cpi*) quantifies general level of prices in the economy. The index is computed by the National Bureau of Statistics of Moldova and consists of: core inflation, food prices, fuel prices and regulated prices. We are aware that last three components can bring additional volatility and seasonal character to the index, however, we believe it is better perceived by the public who is historically used to it in forming inflation expectations.
- Main policy rate (*main_rate*) is applied on the short term auctions of NBM Certificates. In addition we will estimate the impact of the required reserve ratio (*rrr*), frequently employed instrument, representing a

minimum amount of money a licensed bank should keep within the NBM, which is an express and robust measure to balance liquidity in the market.

- MDL/USD nominal exchange rate of Moldavian lei against US dollar (*l_er*) taken as monthly average exchange rate set by the NBM. The interpretation of the rate is based on purchasing power parity theory, namely decreasing of the rate is interpreted as appreciation of a national currency.
- We also allow for contemporaneous impact of 2 exogenous variables: world food index (*l_food*) and world energy index (*l_energy*) to capture external inflation developments, which as Peersman and Smets (2001) suggest can additionally control for price puzzle (i.e increase in price level after a monetary tightening). By treating these variables as exogenous we implicitly assume that Moldavian economy is too small to influence them.
- For the sensitivity specification we add monthly volume of remittances (*l_remit*) transferred by Moldavian citizens from abroad as an additional variable that has a huge implication on defining economic evolution of the country, reaching almost 28% of GDP in 2008[8].

The variables were selected based on economic theory and data availability criteria from publicly accessible national and international sources[9]. Even though it would be preferable to limit our estimation to the period starting with IT regime adoption (2010), the resulting sample would be too small to make reasonable analysis and to draw efficient conclusions. Therefore we decided to begin with year 2004, when all the necessary variables are available. Thus, our sample covers 103 observations (2004M1-2012M09) with monthly frequency (even though similar studies usually employ quarterly periods) to compensate for the small sample size. The plots of the series are available in the figure B.1, appendix B. All the variables except policy rates are taken in logs.

[8] National Bank of Moldova database
[9] National Bank of Moldova database, National Bureau of Statistics of the Republic of Moldova, UNECE statistical database, World Bank database.

Before proceeding with the analysis we check series for cointegration by applying Johansen test (see table 5.1). Its test statistics indicates presence of potential cointegration at 95 percent confidence level.

Table 5.1: Johansen trace test for cointegration

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.40	93.15	47.85	0.00
At most 1 *	0.24	39.81	29.79	0.00
At most 2	0.09	10.50	15.49	0.24
At most 3	0.00	0.79	3.84	0.37

Trace test indicates 2 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

This issue can be solved by using VEC (Vector Error Correction) or VAR in levels. Since VEC proved to contain unit root, we will proceed with modeling VAR in levels allowing in this case for possible cointegration of the series.

5.3 Model Specification

This subsection will present general notes on VAR framework adopted for the monetary shocks analysis on Moldavian economy. Generally, the reduced form of the model is:

$$X_t = A(L)X_{t-p} + B(L)Y_t + u_t, \qquad (11)$$

where X_t and Y_t are endogenous and exogenous vectors of variables, respectively. For our basic specification: X_t'=[*l_gdp*$_t$, *l_cpi*$_t$, *main_rate*$_t$ *and l_er*$_t$] and Y_t'=[*l_food*$_t$ *and l_oil*$_t$], u_t is a vector of reduced-form error terms which can be contemporaneously correlated. Hence, the vector of structural disturbances is a combination of reduced form disturbances and a matrix with structural contemporaneous parameters:

$$\begin{bmatrix} \varepsilon_{l\_gdp} \\ \varepsilon_{l\_cpi} \\ \varepsilon_{main\_rate} \\ \varepsilon_{l\_er} \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 \\ a_{21} & 1 & 0 & 0 \\ a_{31} & a_{32} & 1 & 0 \\ a_{41} & a_{42} & a_{43} & 1 \end{bmatrix} \begin{bmatrix} u_{l\_gdp} \\ u_{l\_cpi} \\ u_{main\_rate} \\ u_{l\_er} \end{bmatrix} \quad (12)$$

Model (11) can be estimated equation by equation using simple OLS. In order to recover the shocks we use a standard Choleski identification scheme where selected ordering plays vital importance. The ongoing hypothesis is that shocks to other variables can have only lagged and not contemporaneous effect on GDP. Prices are immediately affected only by output changes and policy rate shock is not reflected contemporaneously in output and prices but may influence exchage rate straightaway. The latter is influenced promptly by all the variables specified earlier. The choice and ordering of the variables is motivated by economic theory. Usually variables are ordered in the following way: GDP, prices, interest rate and other variables (exchange rate).

As an additional sensitivity analysis we employ alternative non-recursive structural VAR (SVAR) identification scheme. In this model we include a new variable - volume of remittances (foreign personal transfers) that is rather exogenous and not affected by other variables. We also allow for contemporaneous correlation between interest rate and prices, assuming that policy makers at the time of reaching the decision are not informed about the current volume of remittances and level of output. Actual level of output is affected by the volume of personal foreign transfers; prices are influenced both by the remittances and GDP. Exchange rate is assumed to absorb all the shocks at the same time. In the above described specification matrices A and B will contain following restrictions[10]:

[10] Being consistent with previous notation reduced form residuals (u_t) from equation (11) are connected to structural shocks by the following relation: $Au_t = B\varepsilon_t$.

$$\begin{bmatrix} 1 & 0 & 0 & 0 & 0 \\ * & 1 & 0 & 0 & 0 \\ * & * & 1 & 0 & 0 \\ 0 & 0 & * & 1 & 0 \\ * & * & * & * & 1 \end{bmatrix} \begin{bmatrix} u_t^{Remit} \\ u_t^{gdp} \\ u_t^{cpi} \\ u_t^{IR} \\ u_t^{ER} \end{bmatrix} = \begin{bmatrix} \varepsilon_t^{Remit} \\ \varepsilon_t^{gdp} \\ \varepsilon_t^{cpi} \\ \varepsilon_t^{IR} \\ \varepsilon_t^{ER} \end{bmatrix} \quad (13)$$

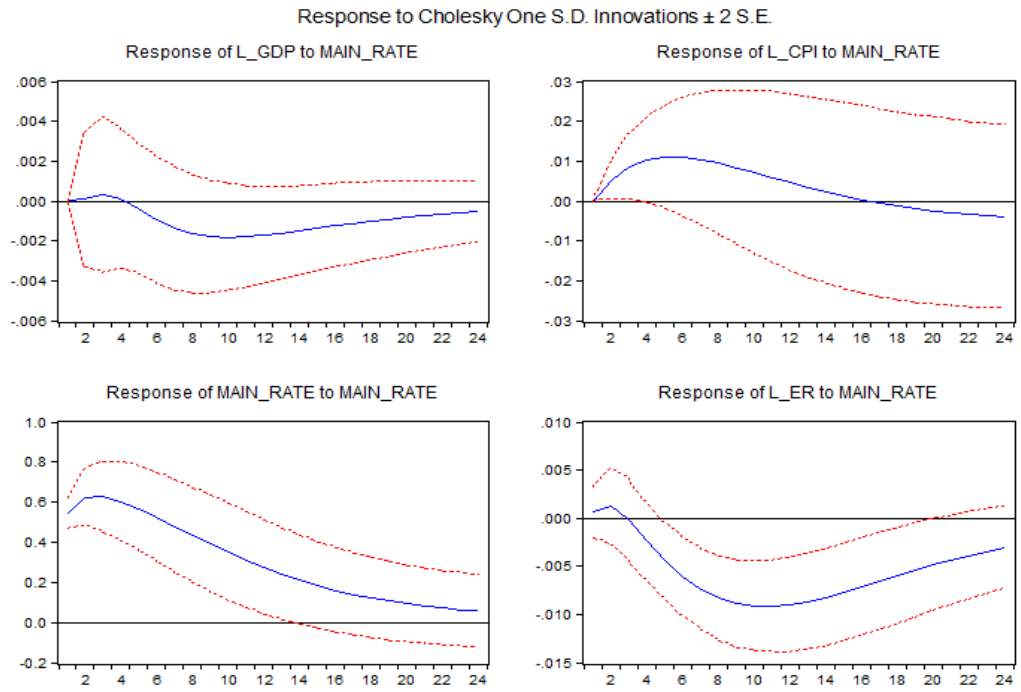
5.4 Estimation Results

In this section we outline our main findings on the monetary transmission mechanism of Moldavian economy. The optimal number of lags included in the system was selected counting on information criteria (see table B.1, appendix B). The majority of the analyzed criteria suggest using 2 lags, which is also convenient for us when relying on the parsimony of the model.

The stability of the whole system is a key assumption, even if some of individual series are not stationary, since differencing may lead to losing important information about long run co-movements between variables. When computing our VAR set-up inverse roots relation to unit circle, all eigenvalues were smaller than one in absolute value (table B.2, appendix B) that confirms stability of the applied model. The baseline model estimation output is presented in appendix B (see table B.3).

Next we present the results of impulse response functions (IRF) describing the effect of unexpected changes to main policy rates in order to seize the current state and speed of policy transmission adjustment to the economy. The figure below represents impulse responses and corresponding confidence intervals of endogenous variables reaction to unexpected tightening of policy rate. The size of the shock is measured as standard deviation shock to structural error term.

Figure 5.1: Estimated impulse response functions to monetary policy shock



The response of economic activity to monetary tightening seems to correspond to economic theory where increase in interest rates induces negative impact on aggregate demand. In our model output gradually falls reaching its bottom (-0.2%) after 10 months and the shock dies away in 2 years. Peersman and Smets (2001) obtain quite similar results for the euro area IR-GDP pass-through (real output reaches bottom point of -15 basis points in 3-4 quarters) in analogue model specification. However, we have to mention that confidence intervals are wide, which induces uncertainty in overall interpretation.

Reaction of price levels to 0.55 p.p. positive shock in policy rate turned out to be opposite from the traditional view, thus exhibiting the "price puzzle", although having rather low significance for longer time lags. Inflation index sharply rises by 1.1 p.p in 5 month interval and then slowly decreases. The price puzzle has different explanations in economic literature. Rusnak et al. (2011) and Hanson (2004) assigns it to improper estimation technique and model misspecification in case when VAR series include periods of switches of monetary regime. We are aware that this critique is valid for our sample, however, Moldova experiences the path of IT only for 2 years and the lack of

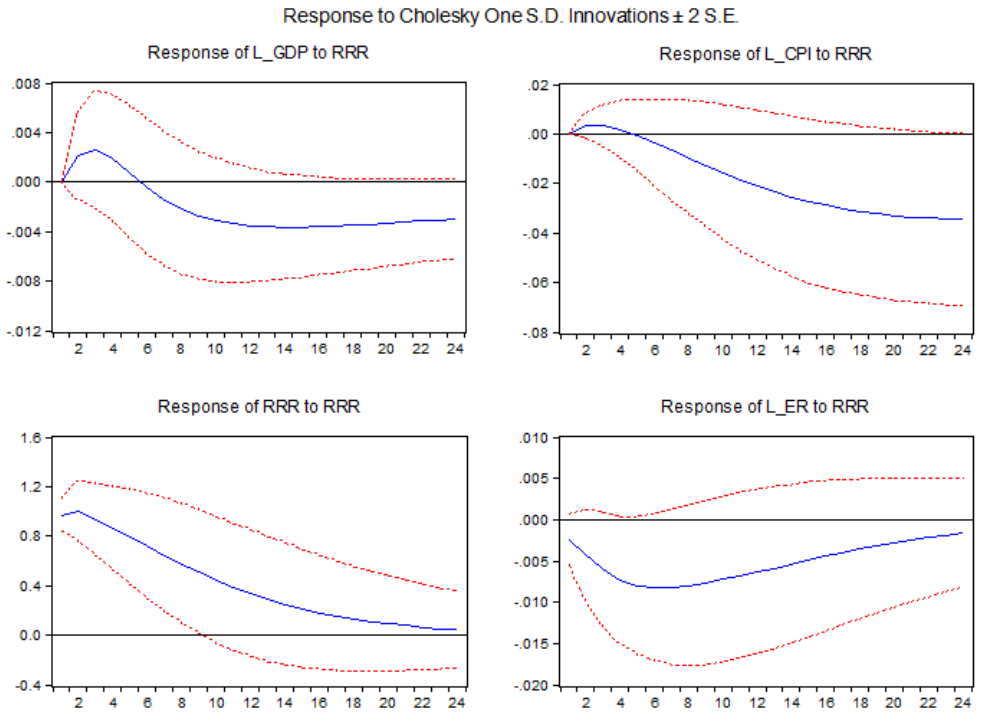
historically available data makes it difficult to assess the IR –prices pass-through more effectively on shorter sample. Another authors, Barth and Ramey (2004) stress that it happens in the economies where dominance of cost channel in transmission is present, since an increase in interest rates gives rise to production costs that directly contribute to higher inflation. The latter can certainly be the case for Moldova where interest rate influence on production costs is responsible for almost 50 percent of deviations in inflation in the medium term as seen in Lupusor, Babin and Popa (2012).

Next we observe that monetary policy innovations are firstly accompanied by slight and statistically-insignificant short-term (2 months) depreciation of the currency followed by persistent and significant appreciation of the national currency, lasting for the next 8 quarters and reaching the maximum change of 91 basis points at the same time as output falls to its bottom level after 10 months. The exchange rate reaction is not fully in line with uncovered interest rate parity hypothesis that predicts an immediate jump appreciation followed by a gradual depreciation of the currency as a result of monetary tightening as was the case observed in Czech monetary transmission (Borys, Horvath, 2008).

Below we present the recursive VAR specification where we replace main policy rate with more extreme measure frequently used by the NBM – required reserve ratio. The model does not include exogenous variables. Notably in our alternative specification, one Cholesky standard deviation translates into almost unitary shock of the monetary instrument. Patters reported in the graph with prices are broadly in line with economic theory - after the 5th month prices start to fall gradually. Nevertheless, relatively wide confidence intervals and the fact that the pressure does not die away diverging in time generates motives to questioning the reliability of the findings. Aggregate demand has the same although more delayed reaction when pressures to required reserve ratio are intensified. In terms of exchange rate response to pressure from this alternative policy instrument, we do observe only appreciation within framed intervals, which reveals no signs of exchange

rate puzzle in Moldavian economy. However, it has to be pointed out that we may not fully trust the results as confidence bands are relatively wide for all the cases.

Figure 5.2: Estimated impulse response functions to RRR shock



When it comes to ER shocks (figure B.2, appendix B) it practically generates no response of the main variables except of initial increase of output in 3 months. In addition confidence intervals are too wide. These results do not correspond to Corricelli (2006) logic about the high exchange rate-prices pass-through in emerging economies due to their high openness. In fact it rather signals about exchange rate channel weakness in Moldova.

The alternative SVAR specification incorporating remittances, output, prices, policy rate and exchange rate variables generates similar impulse responses (figure B.3, appendix B) to contractionary monetary shock as in our baseline model. Notably, aggregate output increases in the first quarter and then continuously decreases. Prices positive reaction became significant for the first 4 month after the shock, which is a sign of the presence of price puzzle in national economy. For the reasons discussed earlier it may serve as an

argument of inefficient functioning of transmission mechanism when monetary policy is not implemented in a way to fully offset inflationary supply shocks (Balke and Emery, 1994). Exchange rate behavior conforms to recursive VAR model findings, except there is no period of depreciation; national currency rather appreciates within 2 years after monetary policy tightening. Moreover the bottom level is deeper in SVAR specification, reaching a significant reduction by 116 basis points in 8 months. Unless otherwise stated the significance of variables' reaction did not improve considerably.

Further, we portray the relative importance of factors affecting prices and policy instrument by using forecast error variance decomposition.

Figure 5.3: Forecast error variance decomposition of prices

Note: VAR recursive specification with main rate (left) and required reseerve ration (right) as policy instruments.

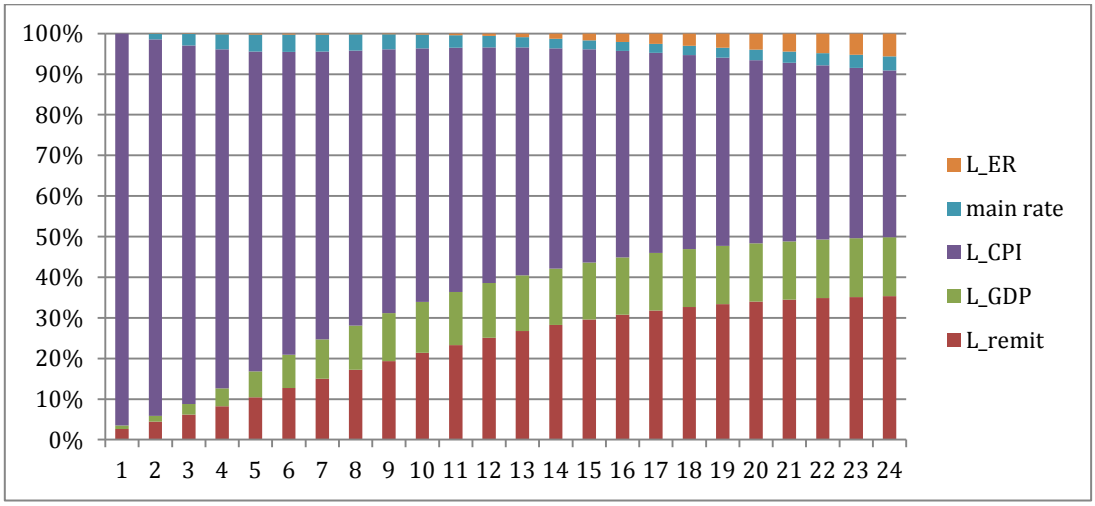
In the left picture we can observe that main contribution (90%) to inflation shocks is given by its own lagged values throughout all analyzed period. Main policy rate exhibits weak influence on prices, reaching the maximum effect of almost 4% in half a year period. One possible explanation can be that public is rather backward-looking in forming inflation expectations and does not fully trust monetary authorities' inflation forecasts. The latter is a common phenomena in transitional countries, which are subject to various structural modifications and high uncertainty in economic develoment.

In case of the graph from the right side, where required reserve serve as policy instrument we can vizualize a more realistic picture, where all included

variables have its own contribution to inflation movements. Output shocks exercise increasing pressure on inflation throughout observed period being responsible for maximum 17.5 % of movements in prices. Alternatve policy tool measure exhibits more power on prices incorporating 18% of CPI movements after 2 years. Exchange rate shows its apparition in 1 year horizon reaching the proportion of 2.5% from overall factors affecting inflation suggesting again poor influence of this variable.

The graph below depicts structural decomposition of the prices coming from alternative non-recursive identification scheme.

Figure 5.4: Forecast error variance decomposition of prices (SVAR specification)



The dominant role in shaping inflation remains to be its own lagged values although in this case it diminishes to 40 % after 2 years. A rising contribution is given by volume of foreign personal transfers that evolves in time and determines up to 36% of price movements in 24 months. Monetary policy rate continues to have a symbolic weight of almost 4,5%. Aggregate output and exchange rate exert maximum influence (14, 5% and 5,6 % respectively) after 24 months.

CHAPTER 6

Concluding Remarks and Recommendations

The second part of the present work was at attempt to evaluate preliminary experience of a developing country choosing to adopt inflation targeting regime. We analyse initial framework of the NBM at the time of IT adoption, first realizations of the regime as well as monetary transmission mechanism within a period of the last 9 years.

Inflation targeting was adopted by the NBM after abandoning managed exchange rate floating. Initial preconditions of central bank independence and primacy of inflation objective stressed by Masson et al. (1997) were partially satisfied long before the idea of changing the regime. Therefore, choosing IT came out to be the best available choice. New framework came together with the reforms in the policy conduct and in the banking system. The latter was mainly addressed to protect private depositors being motivated by the recent economic turndown. As for the policy administration, monetary authority has begun to enhance its accountability to the Parliament and economic agents and has tried to maintain a high degree of transparency of its actions by diversifying the means of communication with the public as well as increasing messages' frequency. These actions contributed to lowering inflation and its expectations to moderate single digit levels and to building good reputation. However, the NBM desire to match multiple and sometimes opposing objectives of low inflation and exchange rate stability has driven to partially sterilized FX interventions and liquidity overhang (Gigineishvili, 2007). Besides sending of sometimes confusing signals to the public, policy effectiveness is undermined by the problems of technical nature related to developing of effective forecasting capabilities and good understanding of monetary policy transmission.

Further, being motivated by the lack of available studies focusing on monetary transmission in Moldova, we wanted to make our own contribution to this field. By using an up-to-date sample, alternative specifications (recursive and structural VAR) and different variables (inclusion of remittances in the system) we develop a VAR framework for the Moldavian economy.

The empirical evidence leads us to conclusion that rate on weekly auctions on NBM certificates failed it role of a correct monetary transmission tool since its unexpected surprises generate the price puzzle. This contrintuitive result was observed in both recursive and structural specifications of the model. We believe that the most plausible explanation of such a response of prices remains to be the idea of inadequacy of interest rate channel in monetary policy transmission, induced by low degree of development of financial markets that interrupts the connection between interest rates and other market instruments (Cechetti, 1999). Moreover prevalence of non-monetary factors in shaping the output (production cost channel) creates additional pressure on inflation. One might also argue that price anomaly may arise because of model misspecification coming from including in the analysis the periods with monetary regime switches. However lack of historical data did not allow us to exclude them from our model. As time passes we recommend to apply the model exclusively on a sample covering implicit IT period in order to obtain more efficient results. The responses of real GDP and exchange rate to monetary surprises conform traditional economic literature view. Both variables decrease and reach its bottom points after 10 months.

Alternatively we confirmed existing results that reserve requirements have much stronger and faster effect on both prices and output, which is not surprising since it was in a past the frequent instrument used by the NBM to control liquidity in the market. However as Lupusor et al. (2012) claim it may have side effects on banking system in case central bank resorts to it too often, putting pressure on credit performance.

Our empirical estimation surprisingly suggests that exchange rate is not anymore a relevant channel for the Moldavian economy. Its shock practically generates no significant movements of the nominal and real variables.

When it comes to inflation shocks composition we found that it mainly depends on its own past values reflecting the backward-looking orientation of the public in forming their expectations. Another important component responsible for almost 36% of price shocks in 2 years turned out to be the volume of remittances transferred by Moldavian citizens from abroad. Whereas interest rate channel importance reaches almost 5%.

The main recommendations can be summed up in the following actions:

- Solving technical problems by attracting competent specialists who can develop and implement an efficient forecasting model of the economy, explain it clearly to the agents and educate them to form their expectations in forward manner by trusting bank's forecasts;
- Improve understanding of inflation sources within a thorough monetary transmission analysis;
- Increase the effectiveness of interest rate channel by improving market infrastructure and strenghening the link between policy, market and retail interest rates (Gigineishvili, 2007);
- Renounce to the practice of frequent FX interventions and maintain consistency of policy actions with inflation objective;
- Increase the quality of reported documents;
- More clear rules and further improvement of accountability and transparency.

Even though there is much space left for improvement of the inflation targeting skills, we believe that NBM chose the right time for regime adoption. As argued by Batini and Laxton (2006) IT abilities can be developed over time and regime introduction creates pressure to do it quickly. The latter is consolidated by the NBM experience that has already undertaken big steps and is making first progress in important directions.

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Appendix A

Table A.1: Sample of countries delimited by region and IT framework

1) CEE

Inflation Targeters	Control Group
Hungary	Bulgaria
Polonia	Croatia
Romania	Latvia
Turkey	

2) Latin America and Caribbean

Inflation Targeters	**Control Group**
Brazil	Argentina
Guatemala	Costa Rica
Mexico	Dominican Rep.
Chile	Ecuador
Colombia	El Salvador
Peru	Jamaica
	Trinidad and Tobago
	Panama
	Uruguay
	Venezuela

3) Sub-Saharnan Africa

Inflation Targeters	**Control Group**
Ghana	Angola
South Africa	Botswana
	Cameroon
	Cóte d'Ivoir
	Ethiopia
	Tanzania
	Kenya
	Nigeria

4) Developing Asia

Inflation Targeters	**Control Group**
Indonesia	Bangladesh
Thailand	China
Phillipines	India
	Pakistan
	Sri Lanka
	Malaysia
	Vietnam

5) CIS countries[11]

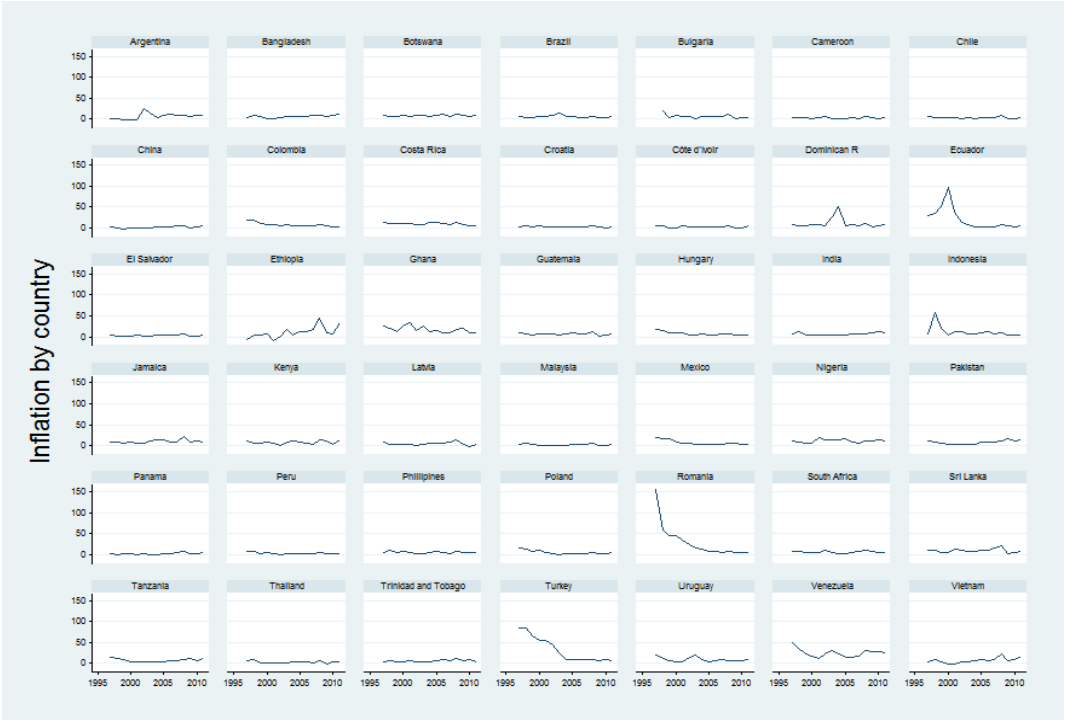
Control group
Kazakhstan
Russia
Ukraine
Uzbekistan

[11] Countries are included in robustness analysis.

Table A.2: Descriptive statistics of the variables

	CPI (y-o-y change)	Inflation volatility (detrended series)
Mean	10.75	2.94
Median	6.23	1.51
Minimum	-8.24	0.11
Maximum	325.03	96.32
C.V.	2.13	2.31
Std. Deviation	22.91	6.81
Skewness	8.34	8.67
Ex. kurtosis	88.15	93.04

Figure A.1: Inflation evolution by country



Note: Angola was excluded because of graphical representation consistency.
Source: Author's calculations based on data selected from IMF WEO.

Table A.3: Means and Standard Deviations of the analysed sample

Country	NIT period		IT period	
	Mean	Standard Deviation	Mean	Standard Deviation
Angola	93.88	101.40		
Argentina	7.09	7.20		
Bangladesh	6.36	2.50		
Botswana	8.39	1.73		
Brazil	5.06	2.63	6.57	2.79
Bulgaria	6.79	4.51		
Cameroon	2.81	1.83		
Chile	5.62	0.72	3.30	1.91
China	1.87	2.38		
Colombia	18.57	0.14	6.09	2.38
Costa Rica	10.30	2.66		
Croatia	3.29	1.59		
Cóte d'Ivoire	3.07	2.05		
Dominican R.	11.01	12.60		
Ecuador	20.34	26.44		
El Salvador	3.18	1.84		
Ethiopia	10.60	13.73		
Ghana	19.39	7.58	13.18	4.46
Guatemala	6.95	1.36	6.54	3.13
Hungary	13.07	4.03	5.47	1.83
India	6.77	3.23		
Indonesia	15.61	17.94	7.9	3.22
Jamaica	10.31	4.12		
Kenya	8.51	3.87		
Latvia	5.05	3.99		
Malaysia	2.50	1.43		
Mexico	15.64	4.59	4.56	0.86
Nigeria	11.53	4.03		
Pakistan	8.02	4.31		
Panama	2.46	2.34		
Peru	5.00	2.77	2.51	1.52
Phillipinnes	6.62	1.59	4.57	1.82
Poland	14.9		4.35	3.30
Romania	48.68	45.87	6.53	1.43
South Africa	6.89	1.71	5.88	2.65
Sri Lanka	9.81	4.77		
Tanzania	8.09	3.79		
Thailand	4.64	3.94	2.63	1.81
Trinidad and T.	6.07	2.66		
Turkey	47.97	29.15	8.34	1.67

Uruguay	9.12	4.93		
Venezuela	24.89	9.73		
Vietnam	7.36	6.44		
TOTAL	**12.40**	**25.92**	**5.39**	**3.14**

Source: Author's calculations based on data selected from IMF WEO.

Figure A.2: Inflation Volatility for the Selected Sample

Source: Author's calculations based on data selected from IMF WEO

Table A.4: Estimates of Inflation Targeting on Inflation and Inflation Volatility during the crisis period

2.A Dependent variable**: CPI inflation (y-o-y change)**						
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
IT*crisis interaction dummy	-3,45** *(1,54)*	-5,94*** *(1,93)*	-1,31 *(3,33)*	-7,71 *(27,90)*	-6,52*** *(2,20)*	-5,49** *(2,58)*
Lagged inflation	0,41*** *(0,10)*	0,41*** *(0,10)*	0,28*** *(0,06)*	0,03 *(0,11)*	0,18* *(0,09)*	0,32*** *(0,05)*
HIGH inflation dummy	63,00*** *(19,23)*	65,14*** *(19,53)*	91,48*** *(13,41)*	163,25*** *(44,43)*	136,85*** *(36,46)*	85,80*** *(17,80)*
AR(1)test				0,23	0,20	0,10
AR(2)test				0,41	0,35	0,34
Hansen J t.				0,15	0,35	0,51
Diff-in-Hansen					0,99	1,00
Instrum.				16	24	25
Observ.	171	171	171	128	171	171
R^2	0,73	0,73	0,71			
2.B Dependent variable**: inflation volatility**						
IT*crisis interaction dummy	-0,65* *(0,36)*	-0,98** *(0,38)*	0,97 *(0,80)*	-6,45 *(7,65)*	-0,84** *(0,40)*	-0,98*** *(0,35)*
Lagged inflation volatility	0,26 *(0,21)*	0,27 *(0,21)*	0,16 *(0,10)*	0,54 *(0,51)*	0,42 *(0,26)*	0,25** *(0,11)*
HIGH inflation dummy	16,31** *(8,10)*	16,10** *(8,15)*	18,54** *(7,46)*	-0,04 *(28,16)*	2,44 *(17,02)*	16,63** *(7,46)*
AR(1)test				0,15	0,13	0,18
AR(2)test				0,19	0,16	0,19
Hansen J t.				0,58	0,93	0,89
Diff-in-Hansen					0,97	0,69
Instrum.				16	24	25
Observ.	171	171	171	128	171	171
R^2	0,51	0,52	0,49			

Note: * statistically significant at 10% level, ** statistically significant at 5% level, *** statistically significant at 1% level. CPI inflation is transformed: $y_{i,t} = 100*\ln(1+CPI_{i,t}/100)$and summed over 3 years. Inflation volatility is proxied by standard deviation of HP detrended CPI over 3 years. Column (1) includes pooled cross-sections OLS, in (2) time-fixed effect (TE-OLS) and country fixed-effect (CTE-OLS) with robust standard errors clustered by country in paranthesis. Column (4) presents two-step Arrelano-Bond difference GMM estimator. Next 2 columns make use of two-step system-GMM estimator which takes inflation targeting dummy as predetermined (5) and as endogenous variables (6). Two-step robust standard errors corrected for finite sample are presented in paranthesis. AR(1), AR(2), Hansen J test and Difference-in-Hansen test report the respective p-values.

Table A.5: Robustness check. Sensitivity to different subsamples. Dependent variable: **CPI inflation** (y-o-y change).

	Expanding the sample (+CIS countries)		Excluding CEE group of countries		Excluding Asian group of countries		Excluding African group of countries	
	S-GMM(p)	S-GMM(e)	S-GMM(p)	S-GMM(e)	S-GMM (p)	S-GMM(e)	S-GMM(p)	S-GMM(e)
IT dummy	-6,59** *(2,79)*	-5,72*** *(2,02)*	-6,91** *(3,11)*	-6,87*** *(2,11)*	-6,52*** *(2,20)*	-6,10** *(2,39)*	-4,68* *(2,77)*	-6,25** *(2,42)*
Lagged inflation	0,28*** *(0,09)*	0,37*** *(0,03)*	0,18* *(0,07)*	0,32*** *(0,04)*	0,30*** *(0,08)*	0,35*** *(0,04)*	0,25* *(0,12)*	0,32*** *(0,09)*
High inflation dummy	106,75*** *(38,18)*	69,02*** *(10,12)*	140,79*** *(31,25)*	89,91*** *(18,00)*	96,27*** *(28,01)*	75,07*** *(13,35)*	100,19** *(31,04)*	62,96*** (11,84)
AR(1)	0,10	0,02	0,19	0,11	0,13	0,08	0,17	0,09
AR(2)	0,42	0,41	0,39	0,36	0,32	0,33	0,33	0,38
Hansen J test	0,44	0,62	0,41	0,68	0,67	0,90	0,55	0,42
Difference-in-Hansen	0,80	0,77	0,71	0,19	0,69	1,00	1,00	0,97
Instruments	34	34	31	30	34	33	32	30
Observations	191	191	144	144	131	131	131	131

Note: * statistically significant at 10% level, ** statistically significant at 5% level, *** statistically significant at 1% level. Inflation is transformed: $y_{i,t} = 100*\ln(1+CPI_{i,t}/100)$and summed over 3 years.Two-step system-GMM estimator which takes inflation targeting dummy as predetermined (S-GMM (p)) and as endogenous variables (S-GMM(e)); robust standard errors presented in paranthesis. AR(1), AR(2), Hansen J test and Difference-in-Hansen test report the respective p-values. Latin America group of countries is not reported since the specification resultd in overfitting of the instruments.

Table A.6: GMM estimators for crisis period with both IT and IT*crisis

	Dependent variable: **CPI infation** (y-o-y change)			Dependent variable: **inflation volatility**		
	D-GMM	S-GMM(p)	S-GMM(e)	D-GMM	S-GMM(p)	S-GMM(e)
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
IT dummy	10,89	-3,32	-5,14	-4,66	-0,44	0,15
	(26,14)	*(3,87)*	*(3,28)*	*(5,84)*	*(0,42)*	*(0,42)*
IT*crisis	-3,37	-3,42	-1,45	-0,71	-0,34	-1,19*
	(5,32)	*(3,74)*	*(3,18)*	*(0,92)*	*(0,65)*	*(0,63)*
Lagged dependent variable	0,08	0,18*	0,34***	0,52	0,43	0,25**
	(0,16)	*(0,09)*	*(0,04)*	*(0,42)*	*(0,27)*	*(0,12)*
High inflation dummy	165,52***	142,71***	80,15***	-1,19	1,24	16,90**
	(50,86)	*(37,43)*	*(16,80)*	*(24,89)*	*(17,76)*	*(7,95)*
AR(1)	0,20	0,19	0,09	0,14	0,13	0,18
AR(2)	0,43	0,35	0,33	0,20	0,16	0,19
Hansen J test	0,17	0,50	0,66	0,56	0,96	0,98
Difference-in-Hansen test	0,04	0,99	0,98	0,37	0,81	0,91
Instruments	128	171	171	128	171	171
Observations	24	35	34	24	35	34

Note: * statistically significant at 10% level, ** statistically significant at 5% level, *** statistically significant at 1% level. Inflation is transformed: $y_{i,t}$ = 100*ln(1+$CPI_{i,t}$/100)and summed over 3 years.Two-step system-GMM estimator which takes IT as predetermined (S-GMM (p)) and as endogenous variables (S-GMM(e)); IT*crisis variable is considered endogenously detemined in the system; robust standard errors presented in paranthesis. AR(1), AR(2), Hansen J test and Difference-in-Hansen test report the respective p-values.

Table A.7: Robustness Check. Estimates of Inflation Targeting on Inflation Volatility

	(1)	(2)	(3)	(4)	(5)	(6)
Inflation Targeting dummy	-0,88**	-0,86**	2,27	-9,40	-0,75**	-0,73*
	(0,42)	*(0,41)*	*(1,98)*	*(9,74)*	*(0,28)*	*(0,40)*
Lagged inflation volatility	0,23	0,23	0,12	0,50	0,36**	0,20*
	(0,16)	*(0,16)*	*(0,09)*	*(0,32)*	*(0,17)*	*(0,11)*
HIGH inflation dummy	29,14**	28,94**	31,81**	5,96	12,72	30,44**
	(14,26)	*(14,20)*	*(14,80)*	*(21,31)*	*(13,79)*	*(14,98)*
AR(1)test				0,14	0,10	0,09
AR(2)test				0,45	0,76	0,55
Hansen J test				0,26	0,76	0,86
Difference-in-Hansen					0,94	0,77
Instruments				24	34	33
Observations	171	171	171	128	171	171
R-squared	0,58	0,58	0,54			

Note: * statistically significant at 10% level, ** statistically significant at 5% level, *** statistically significant at 1% level. Inflation volatility is proxied by standard deviation of CPI over 3 years. Column (1) includes pooled cross-sections OLS, in (2) time-fixed effect (TE-OLS) and country fixed-effect (CTE-OLS) with robust standard errors clustered by country in paranthesis. Column (4) presents two-step Arrelano-Bond difference GMM estimator. Next 2 columns make use of two-step system-GMM estimator which takes inflation targeting dummy as predetermined (5) and as endogenous variables (6); robust standard errors presented in paranthesis. AR(1), AR(2), Hansen J test and Difference-in-Hansen test report the respective p-values.

Appendix B

Figure B.1: Plot of selected variables

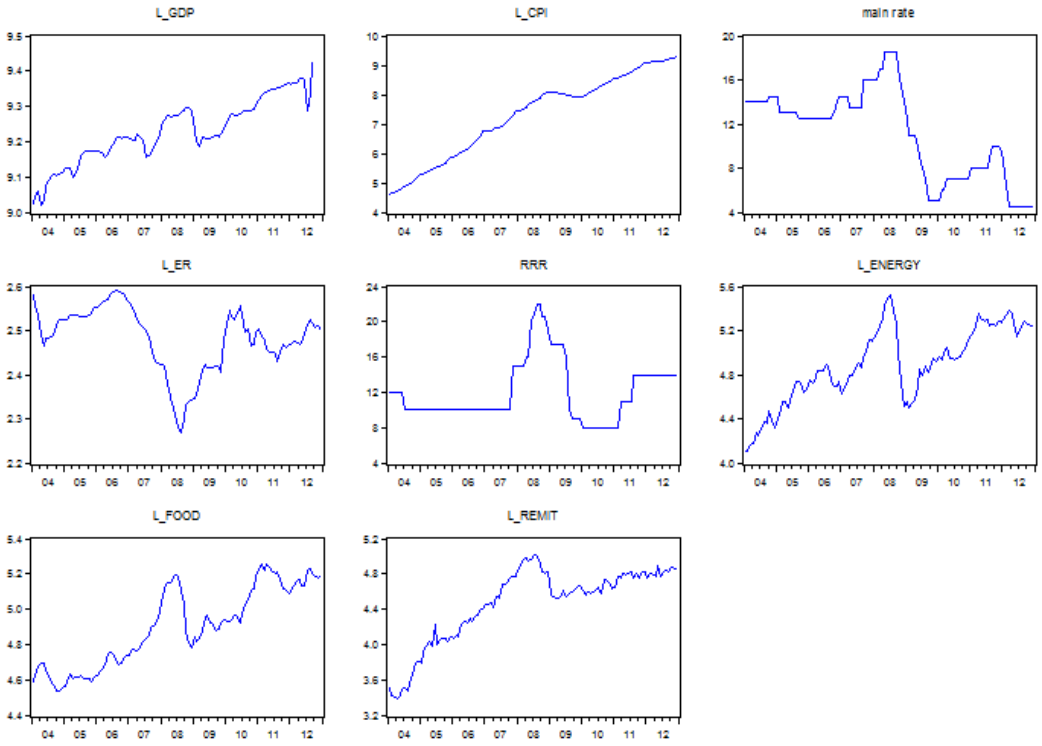


Table B.1: Information Criteria on number of lags included in the model

VAR Lag Order Selection Criteria
Exogenous variables: C L_FOOD L_ENERGY
Sample: 2004M01 2012M09
Included observations: 97

Lag	LogL	LR	FPE	AIC	SC	HQ
0	60.42243	NA	4.33e-06	-0.998401	-0.679880	-0.869606
1	671.1873	1133.378	2.05e-11	-13.26159	-12.51838*	-12.96107
2	706.5876	62.77180	1.38e-11*	-13.66160*	-12.49369	-13.18936*
3	721.4654	25.15420	1.42e-11	-13.63846	-12.04586	-12.99449
4	729.2781	12.56477	1.70e-11	-13.46965	-11.45235	-12.65396
5	739.3483	15.36481	1.95e-11	-13.34739	-10.90539	-12.35997
6	759.3165	28.82004	1.84e-11	-13.42921	-10.56252	-12.27006
7	779.5729	27.56536	1.74e-11	-13.51697	-10.22558	-12.18609
8	801.1989	27.64572*	1.62e-11	-13.63297	-9.916890	-12.13037

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

Table B.2: VAR stability condition check

Roots of Characteristic Polynomial
Endogenous variables: L_GDP L_CPI MAIN_RATE L_ER
Exogenous variables: C L_FOOD L_ENERGY
Lag specification: 1 2

Root	Modulus
0.989337	0.989337
0.856209 - 0.084337i	0.860352
0.856209 + 0.084337i	0.860352
0.710424	0.710424
0.416523 - 0.244330i	0.482897
0.416523 + 0.244330i	0.482897
0.386739	0.386739
0.092770	0.092770

No root lies outside the unit circle.
VAR satisfies the stability condition.

Table B.3: VAR baseline specification output

Sample (adjusted): 2004M03 2012M09
Included observations: 103 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	L_GDP	L_CPI	MAIN_RATE	L_ER
L_GDP(-1)	0.964693	0.016455	-4.602445	0.004379
	(0.11276)	(0.15791)	(3.76419)	(0.09354)
	[8.55525]	[0.10421]	[-1.22269]	[0.04681]
L_GDP(-2)	-0.271766	0.079933	1.592978	0.060497
	(0.10738)	(0.15038)	(3.58474)	(0.08908)
	[-2.53077]	[0.53154]	[0.44438]	[0.67910]
L_CPI(-1)	0.089059	1.532788	5.599029	0.048059
	(0.06402)	(0.08966)	(2.13719)	(0.05311)
	[1.39108]	[17.0965]	[2.61981]	[0.90487]
L_CPI(-2)	-0.078255	-0.544192	-5.914697	-0.050390
	(0.06363)	(0.08911)	(2.12409)	(0.05279)
	[-1.22986]	[-6.10727]	[-2.78458]	[-0.95461]
MAIN_RATE(-1)	-3.28E-05	0.009502	1.142785	0.000949
	(0.00306)	(0.00429)	(0.10218)	(0.00254)
	[-0.01071]	[2.21693]	[11.1845]	[0.37375]
MAIN_RATE(-2)	-0.000539	-0.009611	-0.208706	-0.004082
	(0.00304)	(0.00425)	(0.10141)	(0.00252)
	[-0.17728]	[-2.25931]	[-2.05809]	[-1.61985]
L_ER(-1)	0.147478	-0.039341	-0.293942	1.084468
	(0.11884)	(0.16643)	(3.96728)	(0.09859)
	[1.24094]	[-0.23638]	[-0.07409]	[10.9996]
L_ER(-2)	-0.121023	0.030227	0.690061	-0.249077
	(0.11025)	(0.15439)	(3.68028)	(0.09146)
	[-1.09775]	[0.19579]	[0.18750]	[-2.72338]
C	2.497781	-0.766543	17.55737	0.190084
	(0.58124)	(0.81395)	(19.4029)	(0.48218)
	[4.29736]	[-0.94175]	[0.90488]	[0.39421]
L_FOOD	0.002847	-0.029120	1.818743	-0.078986
	(0.02599)	(0.03639)	(0.86753)	(0.02156)
	[0.10956]	[-0.80016]	[2.09647]	[-3.66373]
L_ENERGY	0.037684	0.030060	0.619690	0.011544
	(0.01321)	(0.01850)	(0.44099)	(0.01096)
	[2.85258]	[1.62489]	[1.40522]	[1.05339]
R-squared	0.967121	0.999732	0.982390	0.968231
Adj. R-squared	0.963547	0.999703	0.980475	0.964778
Sum sq. resids	0.025662	0.050325	28.59706	0.017661
S.E. equation	0.016701	0.023388	0.557528	0.013855
F-statistic	270.6100	34305.01	513.2156	280.3947
Log likelihood	281.1692	246.4841	-80.15727	300.4127
Akaike AIC	-5.246004	-4.572507	1.770044	-5.619664

Schwarz SC	-4.964625	-4.291128	2.051423	-5.338286
Mean dependent	9.231644	7.267713	11.27670	2.479116
S.D. dependent	0.087475	1.356551	3.990017	0.073826

Determinant resid covariance (dof adj.)	8.54E-12
Determinant resid covariance	5.44E-12
Log likelihood	751.2115
Akaike information criterion	-13.73226
Schwarz criterion	-12.60675

Figure B.2: VAR impulse responses to unexpected exchange rate depreciation

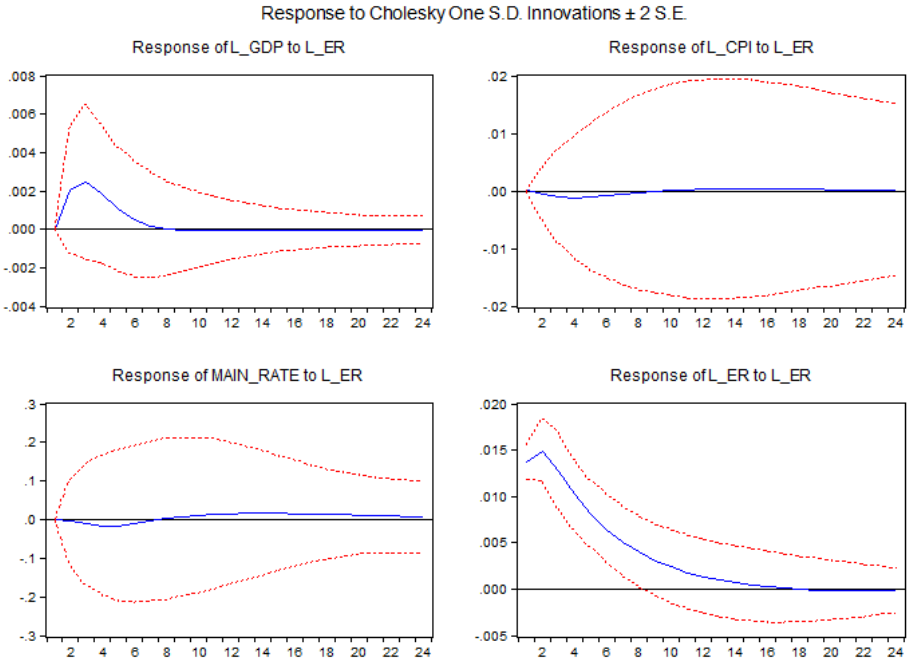
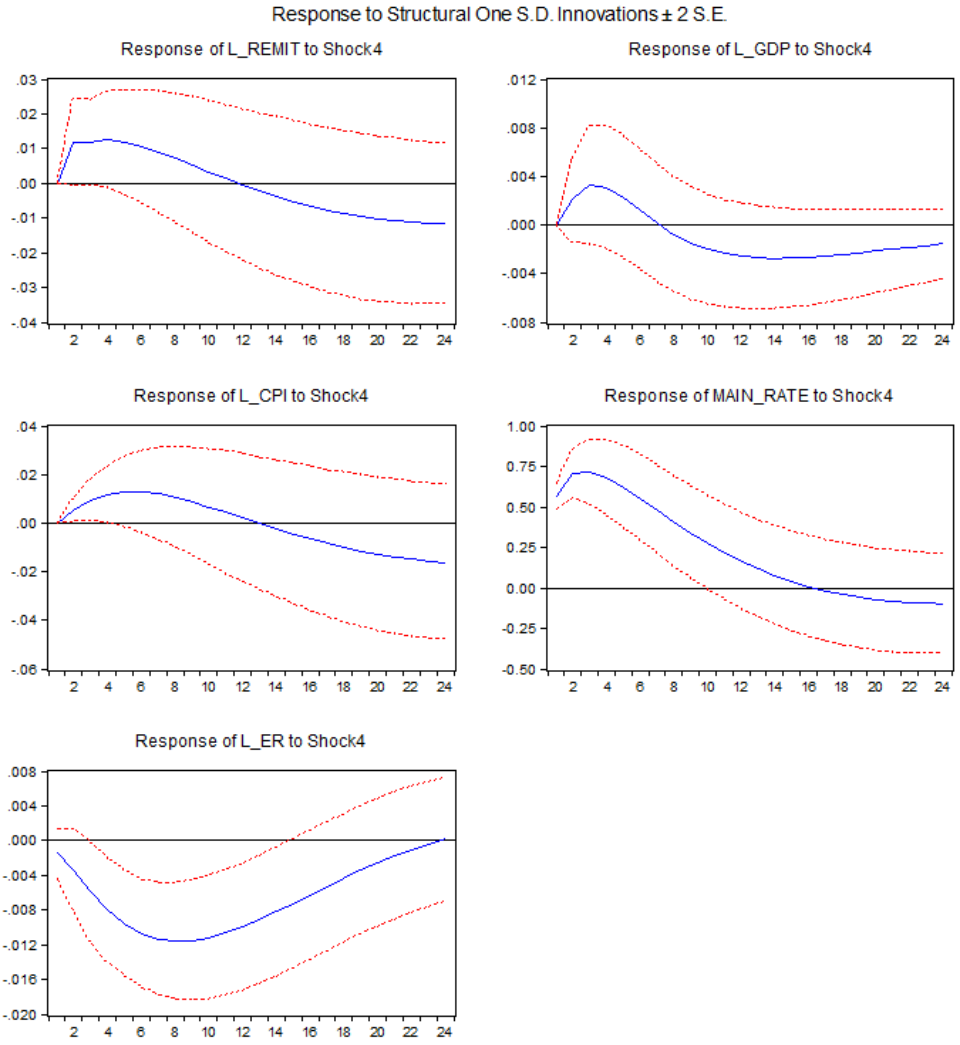


Figure B.3: SVAR impulse responses to monetary tightening



Note: Shock 4=shock to monetary policy rate